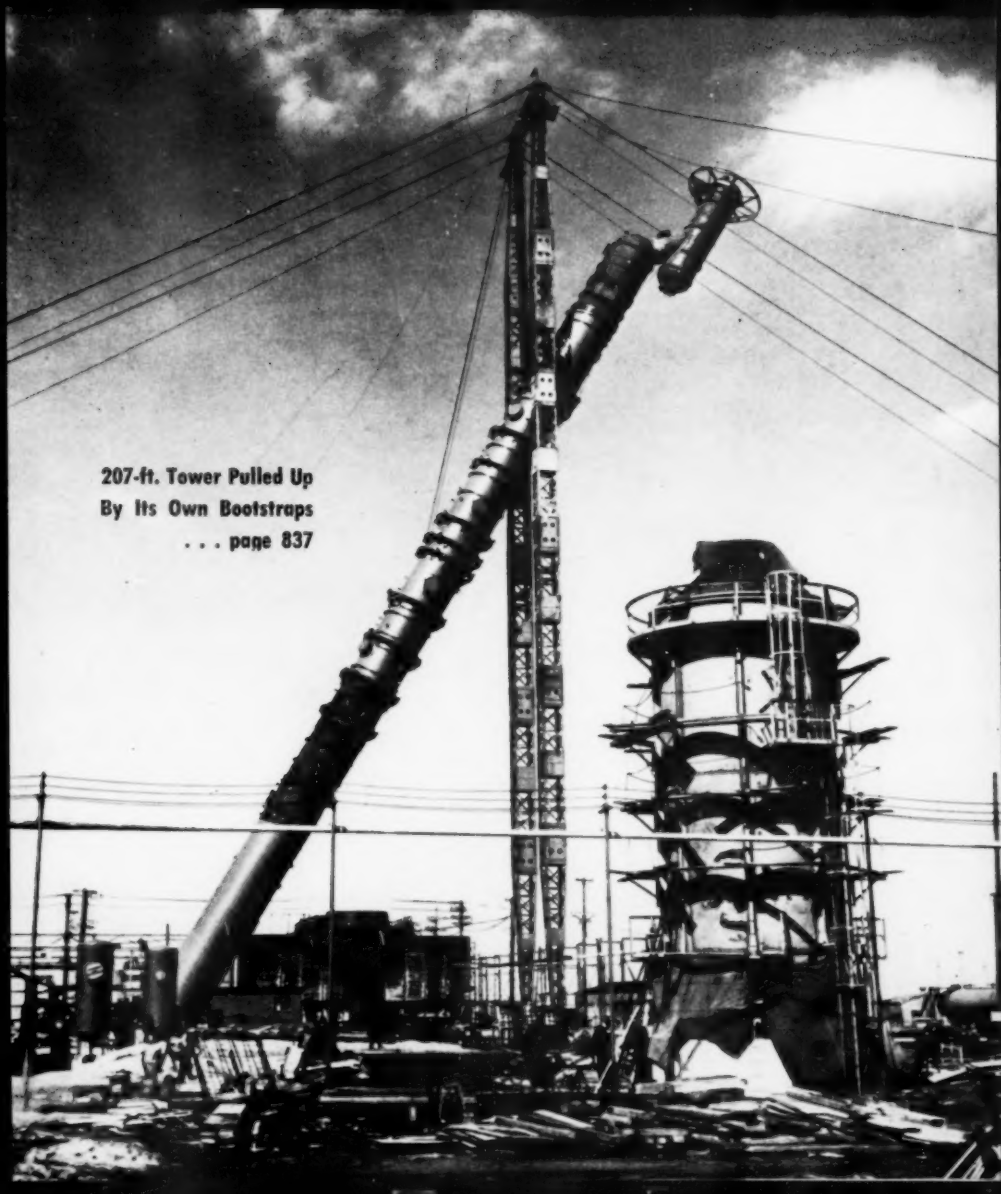
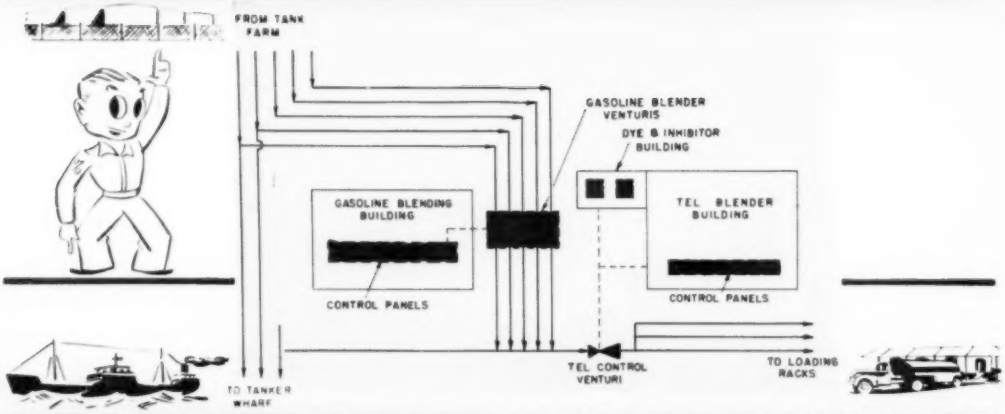
AUGUST, 1951
VOL. 6, NO. 8

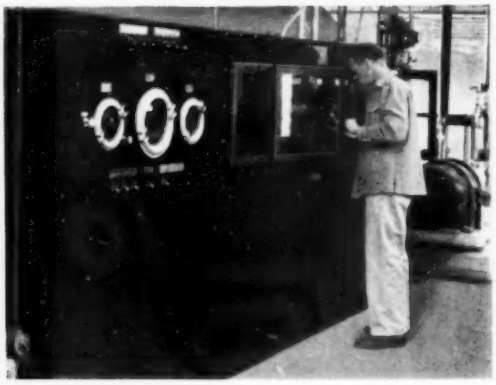
PETROLEUM PROCESSING



207-ft. Tower Pulled Up By Its Own Bootstraps
. . . page 837

Blueprint





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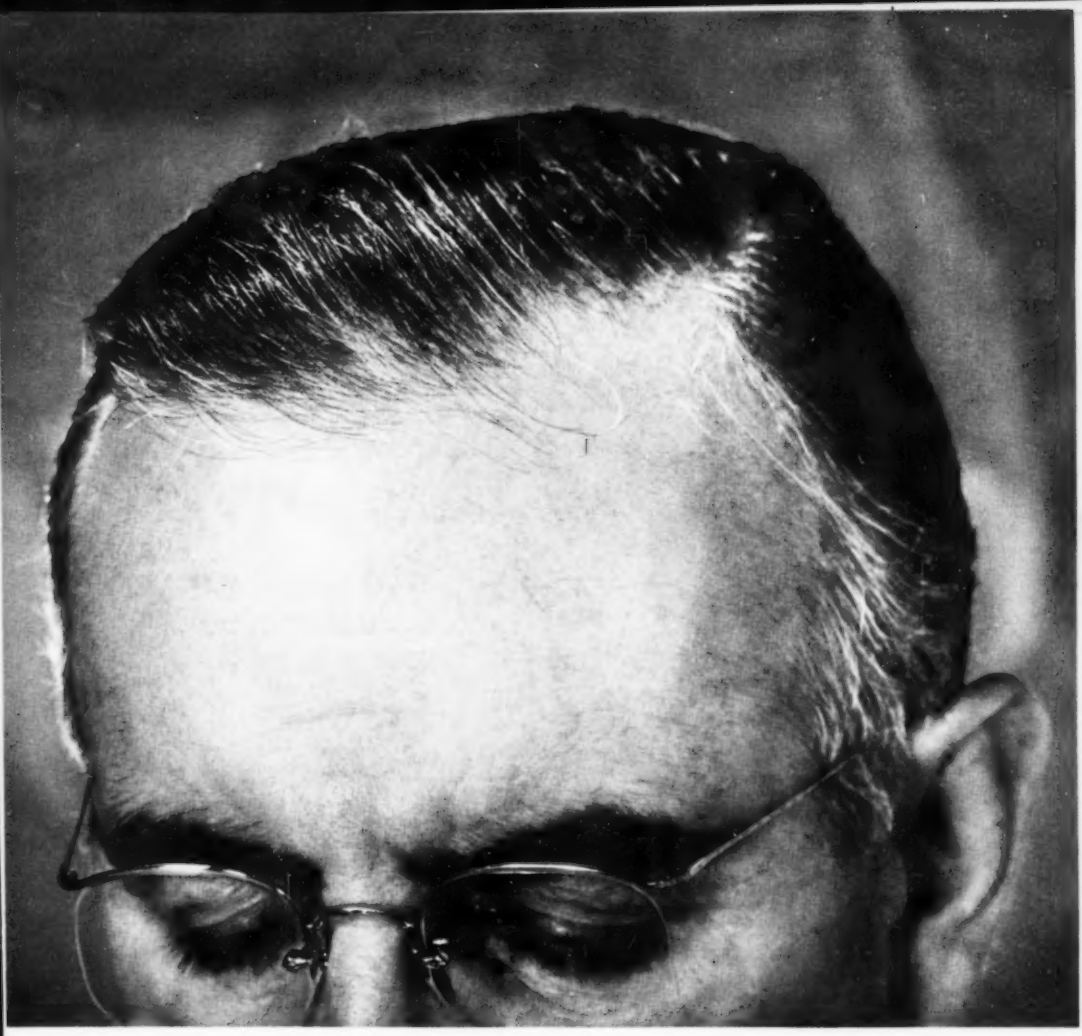

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•

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(continued on next page)

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(continued from preceding page)

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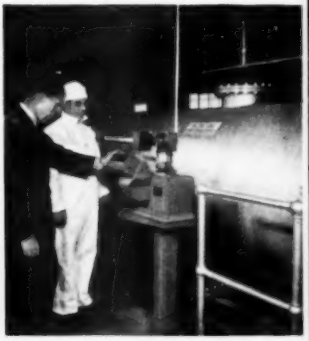
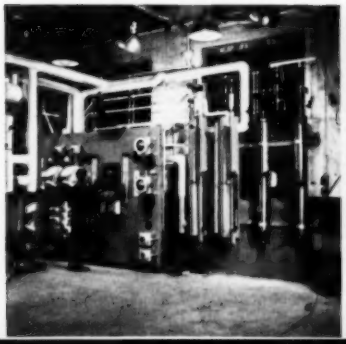
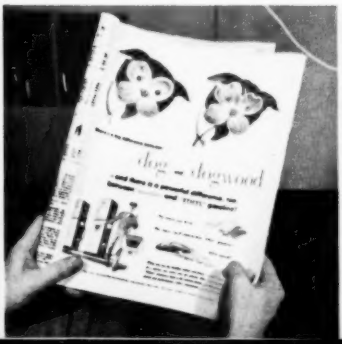
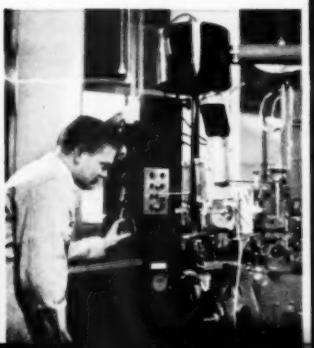


SAFETY SERVICE

GASOLINE TESTING







Chemical Plant...Texas

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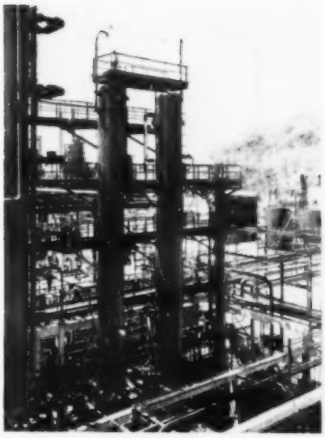
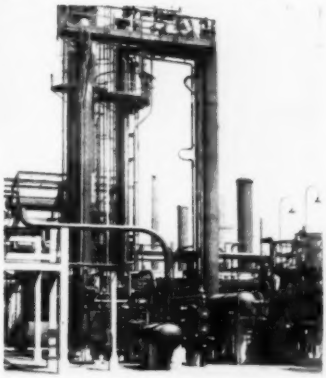


Refinery...Ohio



Refinery...Illinois

Chemical Plant...Arkansas

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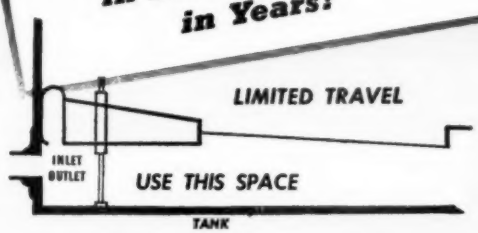

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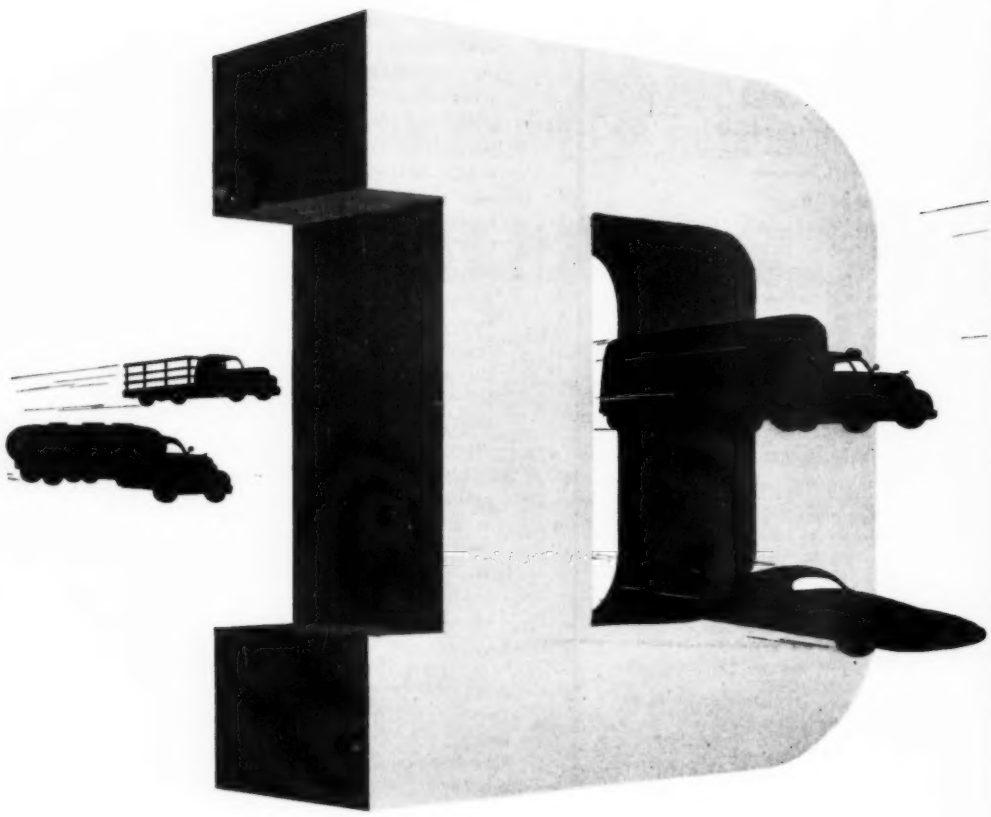

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(To obtain more data on advertised products see page 908)

WHAT'S HAPPENING

Current News Summarized For Oil Men

Expansion

Further expansion of basic refining capacity beyond the additional 1,000,000 b/d goal to be achieved by end of 1953 is likely. The Petroleum Administration for Defense is re-evaluating the mobilization demand picture, and is expected to raise it sights considerably above that figure.

Expansion program of the refining industry so far approved for accelerated tax amortization has reached $565,000,000, with another $165,000,000 approved for allied projects—petrochemicals, TEL, cracking catalysts. Further details in this issue—p. 836.

Canada plans to boost its refining capacity by about 85,000 b/d at a cost of around $80-million. Present Canadian capacity is nearly 350,000 b/d.

Cities Service Co. has authorized M. W. Kellogg Co. to proceed with design and engineering of two Fluid Hydroforming units, to be built at Lake Charles, La. (Cities Service Refining Corp.) and East Chicago, Ind. (Cities Service Oil Co.-Del.). The Lake Charles unit will process more than 19,000 b/d; East Chicago, about half this volume.

Sun Oil Co. plans to build a 10-15,000 b/d refinery at Sarnia, Ont. The new plant will include combination atmospheric and vacuum distillation units and an 8-10,000 b/d Houdriflow catalytic cracking unit. Principal contractor will be Catalytic Construction Co., Philadelphia, with cost of plant estimated about $10 million. Start of construction depends on materials situation but March, 1953 has been set as completion date. High quality motor gasoline, kerosine, heating oil and residual fuels will be produced.

Standard Oil Co. of Texas has awarded contracts for a 940 b/d sulfuric acid alkylation plant to be installed at its El Paso, Texas, refinery. M. W. Kellogg Co. will handle design, engineering and procurement of materials; Catalytic Construction Co. will handle construction. Texas Standard has received a certificate of necessity for the project, and approval for accelerated amortization of 100% of the estimated cost of $2,750,500.

Eastern States Petroleum Co. has commenced construction on a 5000 b/d UOP platformer at its Pasadena (Houston) refinery. It is planned also to add facilities for recovery of benzene, toluene and xylenes from the platformate. To be used in making avgas, project has received DPA certification for 100% fast tax write off on $3,300,000 of eligible cost.

Wilcox Oil Co. will construct a 1500 b/d UOP Platforming unit at its Bristow, Okla., refinery. Universal Oil Products Co. will furnish process designs with construction contract to be let soon. A DPA certification in two parts has been granted: $830,000, 75% and $50,000, 50%. Refinery capacity is 6000 b/d.

Richfield Oil Corp. is studying the possibility of undertaking a $45,000,000 refinery expansion program, construction of which would require two years. Richfield presently has a 10,000 b/d plant at Vindale, Calif., and a 100,000 b/d plant at Watson, Calif.

Universal Oil Products Co., will build a new general office building at DesPlaines, Ill., a Chicago suburb, with accommodations for approximately 350 persons. Contractor is Henry Ericsson Co., Chicago.

Skelly Oil Co. will install a 1500 b/d UOP Platforming unit and increase crude throughput approximately 20% at its 6000 b/d Longview, Texas, plant by modernization of existing facilities. A small catalytic polymerization unit also will be added. Universal Oil Products Co. has contract for design and engineering, with construction to be done by Procon, Inc. Site preparation has been commenced by refinery staff and project completion is scheduled for March, 1952.

Missouri Farmers Assn. (MFA) will install at its Memphis, Tenn., plant the smallest air-lift Thermofor catalytic cracking unit authorized to date. Unit will be capable of handling 1700 lbs. of carbon per hour (about 3000 b/d total throughput) and will cost $1,800,000. Balance of project will boost plant throughput from present 4500 b/d to 6000 b/d by additions to topping plant, and installation of gas recovery, catalytic polymerization and 3 million gals. storage facilities. Koch Engineering Co. is general contractor, with construction to begin immediately and completion estimated for late 1952. MFA plant was formerly known as Delta Refining Co.

Sun Oil Co.'s new aromatics operation at Marcus Hook, Pa., was incorrectly reported in the last issue to have a capacity of 13 million gals. annually of chemical grade toluene (among other products); the correct figure is 30 million gals. Also, the new recovery method to be used is Sun's "Arosorb" process—described in detail this month on p. 833.

Lakeside Refining Co., Kalamazoo, Mich., is installing a 1000 b/d Perco catalytic reforming unit. Koch Engineering Co. is contractor, with completion scheduled for mid-'52.

Skelly Oil Co. is enlarging the capacity of two natural gasoline plants. The No. 2 plant at Eunice, N. Mexico, is being doubled in size, to a throughput of 60,000 Mcfd., and when completed shortly will produce 160,000 gal. daily of natural gas liquids. At Velma, Okla.,

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

plant throughput is being jumped 27,000 Mcfd. and liquids production 50,000 gal. per day on work nearly completed to a total of 57,000 Mcfd. of gas and 110,000 gal. daily of liquids. Design, engineering and materials purchasing for both jobs is being handled by Skelly.

Shell Chemical Corp. will add a multi-million dollar synthetic ammonia plant to its other petrochemical manufacturing units at Dominguez, Calif. Construction will begin this year with completion scheduled for late 1952.

Industrial Mobilization

Smaller refiners are getting a bigger share of the accelerated amortization projects, based on their plant capacities, than are their bigger brothers. Figures recently compiled by the Petroleum Administration for Defense show that over 26% of the additional crude oil topping capacity and 16% of the new catalytic cracking capacity recommended by PAD for tax certificates is being built by firms who are listed among the 184 smallest companies in the country. Those 184 companies at present operate only 10.63% of the nation's crude capacity and 3.71% of the catalytic cracking capacity.

Deliveries of controlled materials for use in petroleum and gas operations can be rescheduled by PAD, according to a recent order issued by National Production Authority (Supp. 1 to Del. 13). A shipment of structural steel, for example, can be diverted from one refiner who may not yet be ready to start construction to another whose defense production program is being hindered because of delays in delivery of his own steel order. PAD's rescheduling authority applies only to orders on which priorities assistance is or may be made available, and to cases where no change in production schedules would be required.

APPOINTMENTS—Richard M. Morrison (manager of purchasing dept. for The Texas Co.) as deputy director at PAD's Materials Division . . . **C. E. Davis** (vice president in charge of manufacturing, Shell Oil Co.) deputy director of PAD's Refining Division . . . **Donald R. Teis** (formerly materials supervisor for the Creole Petroleum Corp. in Venezuela) as asst. director of PAD's Production Division, succeeding **Millard K. Neptune**, resigned . . . **Walter G. Whitman** (recently head of MIT's Chemical Engineering Dept. and prior to that associate director of research for Indiana Standard) as chairman of Defense Department's Research and Development Board.

Markets, Prices

British-Iranian oil dispute in the Middle East, involving some 530,000 b/d of refining capacity at Abadan plus additional quantities of crude, acted as a firming factor in the U. S. Gulf market in July. In other refining districts, supplies were plentiful with prices easy.

Through July 28, Asiatic Petroleum Co., buying agency for British Government, had bought approximately 15,000,000 bbls. of various refined products in the U. S. for export during last half of 1951 to areas of short supply from Abadan. Bulk of the material came from the Gulf Coast, although some purchases were made from Atlantic and Pacific Coast plants. Latter supplied some 4,000,000 bbls. of heavy fuel—the product in shortest supply at the Gulf and along the East Coast.

Floods in Kansas, which halted shipments via the Great Lakes Pipe Line for an 8-day period and disrupted rail transportation north from the Mid-Continent, caused considerable backing up of products at refineries. Some distress-lot offerings were shoved on the market, with light products quoted 0.375 to 0.5c per gal. below generally quoted prices, and heavy fuels 5 to 10c per bbl. below.

Principal price development in July was a 0.5c per gal. increase, to 8c, in the cargo price for No. 2 fuel at the Gulf. Aside from this, changes in primary markets were confined to specialty products.

Crude scale wax in Western Penna. was off 0.5c per lb. to 5.5c in tank cars, FOB refineries, reflecting substantial build-up in inventories. Most recent report of Bureau of Mines showed that stocks of all waxes in U. S. as of end of May had increased to 162,400,000 lbs., highest level in nearly 20 years.

Foreign

Ruhrchemie A. G., Oberhausen-Holton, Germany, has contracted with Koch Engineering Co. for construction of a complete 6000 b/d refinery, including crude and vacuum distillation, thermal cracking, 3500 b/d Perco catalytic reforming, gas recovery and treating facilities. Completion is estimated for early 1952.

Esso Petroleum Co. has placed the first unit of its new refinery at Fawley, England, on stream—a 60,000 b/d crude topper originally scheduled to begin operating in 1952. When completed, the plant will have a capacity of 115,000 b/d. Esso also plans to start work soon on a major addition to the plant to extract sulfur from refinery gases—at the rate of about 12,000 tons per year.

Industrie du Petrole S.A. (IPSA) is adding a 1000 b/d catalytic reforming and desulfurization unit to its plant at Rotkreuz, Switzerland. Koch Engineering Co. is furnishing designs, with construction being done by plant staff.

Miscellany

Sinclair Refining Co. is moving its New York offices to the new 26-story Sinclair Oil Building at 600 Fifth Ave., New York 20, with the transition scheduled to be completed Aug. 20. Telephone number remains unchanged—CIrcle 6-3600.

A new solvent extraction process has been developed by Dow Chemical Co., in cooperation with Universal Oil Products Co., for the recovery of aromatics from hydrocarbon materials. UOP will act as licensing agents to the petroleum and petrochemical industries. The new process, named UDEX, reportedly uses diethylene glycol as the solvent and is being installed in at least one refinery.

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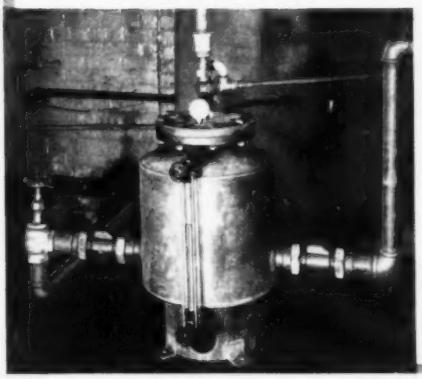

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Motor and switch totally enclosed, this pump has Underwriters approval for Class I, Group D, and Class II, Groups E, F and G hazardous locations. These include gasoline, solvent vapors, metal dust, natural gas, carbon black, naphtha, alcohol, grain dust, acetone, lacquer, coal and coke dust, etc. Made of copper and bronze throughout, this pump is corrosion proof, durable, thoroughly dependable. Write for Bulletin 4929.

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ENJAY products are marketed in bulk or in quantities to fit your requirements.

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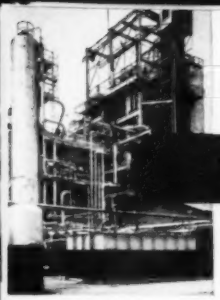


TOMORROW... IN PETROLEUM TECHNOLOGY

Possible Effects of Today's Developments On Future Operations

By the Editors of Petroleum Processing

"Mechanical Octanes" Talking Point for New Chrysler Engine

THE general public had its introduction to "mechanical octanes" as a means for control of engine knocking, as well as fuel octanes, when the new Chrysler models were announced. " 'Mechanical octanes' give top performance on non-premium grade fuel. The Engine of Tomorrow on the gasolines of today," read the advertising in many newspapers.

With the 1951 passenger car models, the Chrysler Corp. announced a new valve-in-head, Vee type, 8-cylinder engine of 331 cu. in. piston displacement in the larger models of 7.5-1 compression ratio. It superseded an L-head, 8-cylinder-in-line engine of 323 cu. in. displacement. While the engine will operate satisfactorily on present regular grade fuels, it is stated that further improvements are assured by continued development and use of higher quality fuels.

After long and continued study of both conventional and unconventional types of combustion chamber design, the hemispherical combustion chamber was adopted for use in the new engine as being the most practical design to assure effective fuel utilization.(1) The accompanying sectional drawing indicates the main features of the design. The valves are located within a nearly hemispheric cavity in the cylinder head. They are laterally disposed in a plane that passes through the cylinder centerline and is perpendicular to the crankshaft axis. A wide angle is formed between the valve stems. The spark plug is centrally located.

Features of design are listed that are conducive to high volumetric efficiency. "The valves are not crowded together, nor surrounded closely by the combustion chamber walls, and thereby they are fully effective in the flow of the fuel-air mixture and the exhaust gases. Both ports are ideally streamlined with a minimum of directional change, such port shapes being permitted by the specific location and lateral disposition of the valves. The obvious complete separation of the ports, together with the wide space between the valve seats, assures that the incoming charge picks up a minimum of heat from the hot exhaust. In addition, the flow within the cylinder is not restricted by any barriers or tortuous passages."

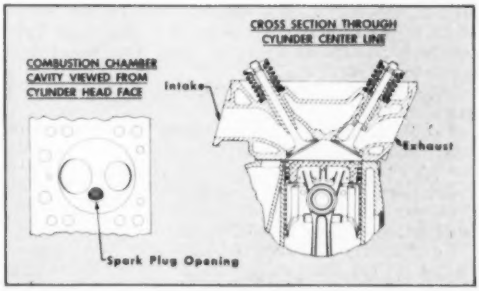
Another advantage of the hemispherical combustion chamber is said to be the low heat rejection to the coolant. Potentially, this means a smaller, lighter and less expensive coolant system for an engine of the same power.

A number of factors permit the use of the 7.5-1 compression ratio in the new engine without requiring the use of premium grade gasoline. The principal ones are:

Absence of pre-ignition

Relatively low increase in octane number requirement due to combustion chamber deposits

An increase in the apparent octane number rating of the majority of commercial gasolines.



Effective fuel utilization is achieved in the Chrysler Corp.'s new "mechanical octane" engine by using a hemispherical combustion chamber

The announcement of the new Chrysler engine presents tangible evidence that progress toward inhibiting engine knock is being achieved by mechanical design features. Further achievement in this direction, together with the improved fuels that will be forthcoming, may make it possible to bridge the gap between the present and materially higher compression ratios with less difficulty than refiners have anticipated. —V.B.G.

(1) "Development Highlights and Unique Features of the New Chrysler V-8 Engine," W. E. Drinkard and M. L. Carpentier, Chrysler Corp., before the SAE National Passenger Car, Body and Materials Meeting, Detroit, March 6-8, 1951.

Reforming of Natural Gasoline May Solve Surplus Problem

FOR a long time the natural gasoline industry has been seeking some means to avoid the embarassing surpluses of its principal volume product which develop seasonally. These excesses come about because natural gasoline often does not have a high-enough octane rating. Most refiners want to use no more than they absolutely have to in order to meet volatility requirements in their own motor fuel. Likewise, it cannot be used directly as motor fuel in the majority of automobiles with satisfactory results.

Needed has been some economic means of upgrading quality, or of producing a salable product for all seasons of the year.

A solution to the problem and a possible blueprint of things to come in the gas processing field is seen in the recently announced project of Atlas Processing Corp. to catalytically reform natural gasoline to produce benzene, toluene and xylene concentrates.(1)

Feed stocks for the new Atlas project, to be built at Shreveport, La., will be natural gasoline streams from several nearby gas processing plants, piped directly to the Atlas plant. There the stock will be reformed, using UOP's Platforming process, and the

resulting aromatic products recovered, using an extracted distillation unit designed by Shell Development Co. Approximately 17,600 gals. daily (about 420 b/d of benzene will be produced when the plant goes on stream.

Further details on the application of catalytic reforming to the processing of natural gasoline were given in a recent paper before the Natural Gasoline Assn. of America.[2] There it was reported that the high-boiling components of the natural gasoline feed stream (above 150° F.) usually serve as the charge stock to the reformer. After being reformed to high-octane aromatics, this "kitty" then may be used in a number of ways:

(1) Blended back with the light ends to produce a satisfactory motor fuel.

(2) Separated to produce avgas blending agents, with the unused materials being blended back with the light ends for motor fuel.

(3) Solvent refined to segregate toluene, xylene concentrates and benzene, and the remaining light ends disposed of by the best means available.

All of this doesn't indicate that every natural gasoline or cycling plant will install a reformer of its own. But operators of these plants will probably give more thought to an arrangement similar to that of the Atlas group—of combining the production of several plants in a relatively small area to secure a sufficient volume of charge stock to make a reformer of economic size practical. —D.P.T.

(1) Petroleum Processing, "What's Happening," June, 1951, p. 571.
(2) "Processing of Gas Distillate Raw Materials," by C. R. Williams and R. E. Sutherland, presented at the 30th Anniversary Meeting, Natural Gasoline Assn. of America, Tulsa, April 25-27, 1951.

Interest Grows in Acetylene As Chemical Building Block

TWO developments serve to focus attention in the chemical and petroleum industries on acetylene as a raw material for building organic chemicals.[1, 2] The first is the fast growing use of the material for making plastics, synthetic fibers, rubbers, a wide variety of drugs, and other products. The production of acetylene gas has grown four-fold since the last pre-war year (1939) and it is now being made at the rate of 6,000,000,000 cu. ft. per year. This is equivalent to about 414,000,000 pounds, of which nearly 300,000,000 is converted into chemicals, the remainder being used for welding and torch cutting.

A second development, of even greater interest to the oil companies, is the fact that natural gas is giving calcium carbide formidable competition as a base from which to make acetylene. Concrete evidence of this fact is the 30,000,000 plant Monsanto Chemical Co. is building at Texas City to produce acetylene from gas, as an intermediate in the production of acrylonitrile for its new synthetic fibre Acrilan. Union Carbide & Carbon Co.'s Texas City plant is being doubled in capacity. It makes acetylene by the Sasche process, using natural gas or methane and oxygen.

Processes for making acetylene from natural gas are not new to refiners. The Schoch process, developed at the University of Texas, uses an electrical discharge that creates a low-temperature arc. Natural gas is passed through a series of circular chambers, each of which has three electrical discharge points. The discharge is created by using a stationary electrode just outside the gas exit port, with a rotating impeller in the chamber as the other electrode. Gas speeds through the combustion zone, is made to react by the electrical discharge, then is recirculated through coolers. In a 20,000,000 lb./year plant, cost including purification is estimated at 9.8 to 10.6c per lb., compared with about 11.3c by the carbide route.

The Wulff regenerative process, like the Schoch, is known in the refining industry but has not been applied commercially as yet to acetylene manufacture as far as is known. This process cracks natural gas at 2600° F. in a regenerative type furnace. It is estimated acetylene should cost between 8.1c and 9.2c by this process.

One disadvantage facing the plants in the southwest making acetylene from gas is their considerably higher shipping rate on the product, as compared with plants in the east using the carbide process. Looking ahead, this might mean chemical manufacturing plants on the Gulf Coast, close to their supply of the acetylene raw material. —V.B.G.

(1) "Chemists Give New Play to Acetylene", *Business Week*, July 7, 1951, pg. 42.
(2) "Acetylene Miracles", *Wall Street Journal, Chicago Journal of Commerce Edition*, July 7, 1951.

New Dehydrogenation Catalyst Gives Higher Butadiene Yields

A NEW dehydrogenation catalyst has been announced by Dow Chemical Co. for the dehydrogenation of normal butylenes to butadiene which will increase yields without requiring substantial alterations to existing plants. A pelleted calcium-nickel phosphate, it offers 92% yields of butadiene against the approximately 70% achieved by the standard iron-magnesium oxide promoted catalyst.[1]

To use the new catalyst in existing plants, achieving approximately a 10% increase in yields, requires only the strengthening of the catalyst supporting grates in the reactors. Steam and reactor feeds then can be increased to the limit permitted by the feed heater and steam superheater equipment in the plant. The waste heat boiler, compressor and steam quenching facilities will be adequate because the new catalyst does not produce as much non-condensible gas as the standard catalyst now in use. The butadiene purification facilities might be overloaded by the additional 10% of production, however.

More butadiene purification must be added if the ultimate in yield—35% increase in conversion per pass—is to be achieved. Because the charge of butylenes will be greater, additions to feed heater and steam superheater capacity also will be needed.

Tonnage-wise or volume-wise, as the oil industry computes them, butadiene has never been a large volume product, nor has the refinery B-B cut required as a raw material. However, it will be remembered that in World War II a considerable proportion of the butadiene capacity developed was to be supplied from alcohol because it was considered that, coming from an agricultural commodity, the supplies could theoretically be inexhaustible. Nevertheless, alcohol butadiene is relatively expensive by comparison to petroleum butadiene—a cost factor reflected in the price of synthetic rubber.

The new Dow catalyst may not only give an inexpensive boost to petroleum butadiene capacity, but it could also mean a reduction in the amount of alcohol used for this purpose and, with this, a reduction in the cost of synthetic rubber. —D.P.T.

(1) "Butadiene Bonus," *Chemical Week*, p. 21-22, June 9, 1951.

try SANTOLENE C to stop tanker corrosion

Internal corrosion in tankers may cost you as much as $90,000 a year in maintenance, including cost of critical materials, down time and manpower. Examine Santolene C, corrosion inhibitor for light petroleum products, as a means of controlling tanker corrosion.

Santolene C, added to the light petroleum cargo, is believed to form a protective coating on metal. This coating remains to protect the ship when condensation covers the empty hold or when sea water is used for ballast.

Santolene C has also been proved effective in the laboratory and in product pipe-line service. Results have been confirmed through use by a major oil company which, for more than a year, has marketed all types of light petroleum products.

Santolene C is product-soluble. It burns completely with the fuel, leaving no residue. Diesel and gasoline engine tests have proved that Santolene C does not reduce engine cleanliness, causes no injector fouling, has no adverse effect on any factor of engine performance.

If you have a corrosion problem with light petroleum products in refineries, pipe lines, tanks, tank cars or tankers, Santolene C may solve it for you. For technical information on the use of Santolene C, write, wire or telephone MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri.

URGENT—If you have empty carboys or returnable drums, please return them to your supplier promptly. They're urgently needed. Containers are scarce!

Santolene: Reg. U. S. Pat. Off.

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CHEMICALS AND PLASTICS

SERVING INDUSTRY . . WHICH SERVES MANKIND

(*To obtain more data on advertised products see page* 908)

REVOLUTIONARY

Rotomotor

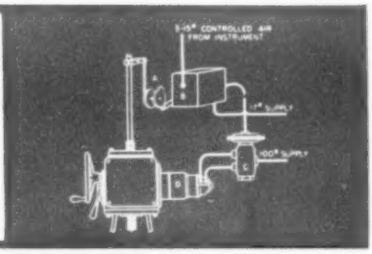
WINS REFINERY ACCEPTANCE

New All-Pneumatic Slide Valve Operator Cuts Costs on Fluid Catalytic Cracking Units

This new air-operated Rotomotor makes it unnecessary to invest the heavy capital required for hydraulic systems. Using ordinary plant air supply, the Rotomotor is more economical for operating slide valves in control of spent catalyst, regenerated catalyst, and back pressure of flue gas on stack valves. In addition to being dependable, rugged and compact, the Rotomotor is accurate and sensitive to instrument output pressure changes as small as .025 psi.

It is capable of handling thrust loads up to 60,000 lbs. with stem travels up to 36". It is inherently a self-locking mechanism because it operates through a gear drive and threaded stem. A continuously connected handwheel and declutching lever provide for manual operation if needed.

Rotomotors may be mounted on any catalyst slide valve of your choice at the manufacturer's plant and shipped to you as complete units ready for installation.



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- Taylor Refining Company
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- Canadian Oil Refinery Ltd.
- Dunkirk Refinery (France)

HOW IT WORKS:

POSITIONING DEVICE (B) determines *actual* valve stem position by means of tape and cam connection (A) and *desired* stem position by air impulse from control instrument. Corrected output air pressure from (B) then is fed to AUXILIARY PILOT (C) which ports main air supply to PNEUMATIC MOTOR (D) driving gear box clockwise, or counterclockwise repositioning stem and completing pneumatic control loop.

SEE THE ROTOMOTOR EXHIBIT AT THE INSTRUMENT SHOW

Conoflow Booths 126-128 in Houston, September 10-14

Write for New Bulletin PP

Cono-Controls

CONOFLOW CORPORATION

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LETTERS

How to Order Valves

I have read and reread the article "How to Get What You Need When You Order a Valve," July, p. 722 with much interest and certainly feel that those connected with the preparation of this article are to be highly complimented on an excellent job from the standpoints of the material presented and the way in which it was presented. I think the field has been covered admirably and actually there is little that may be added.

All too many times people ordering valves simply take them for granted, whereas those of us who have been connected with the operating side of the business for a number of years know that a good deal of trouble surrounding a processing plant stems from valve difficulties, a large amount of which are due to improper handling in installation, packing, or failure to remove dirt from the valves and lines. Also, too many people feel that they are experts on valves and insist on specifying trim materials in particular which are not suited to the service. When trouble occurs it is naturally the fault of the valve manufacturer.

Although added personnel and steps in the processing of an order are not desirable, I feel that a good many plants could save themselves much time and many dollars by routing valve requisitions through an individual who is familiar with the problem and the product.

F. W. WILSON
Chief Engineer
Henry Vogt Machine Co.
Valve & Fitting Dept.
Louisville, Ky.

Instrument Fundamentals

. . . In my opinion, the verbiage is good, the description concise and clear. ("Refinery Instruments—What Makes Them Tick?" PETROLEUM PROCESSING, July, 1951, pp. 730-733).

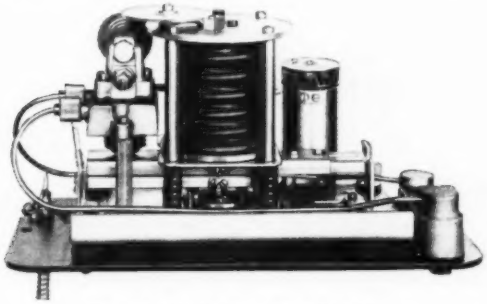
I am inclined to be critical of the illustrations, however, and believe that more line drawings should be used, or the photographs touched up to eliminate odds and ends that always puzzle the neophyte.

For Example, Fig. 3 on p. 731 depicts a helical pressure element. It also includes a calibrating adjustment that will draw more eye attention because of its peculiar shape than the helical coil. The text does not mention this doo-dad and undoubtedly the reader will be frustrated by such eye-catching gimcracks that are not mentioned in the text.

E. J. GRACE, Jr.
Chief Instrument Engr.
Sun Oil Co.
Philadelphia, Penna.

DYNAMIC ACCURACY means more today than ever before!

Accurate Measurement of changing temperatures and pressures is the vital first step in instrumentation, whether indicating, recording or controlling. Today, TRANSAIRE* Transmitters set new standards for sensitive and accurate measurement.



TEMPERATURE:

Taylor TRANSAIRE Temperature Transmitter with Speed-Act* lets you measure and transmit smallest temperature changes up to 1000 feet with great accuracy! The *only* temperature transmitter that gives you:

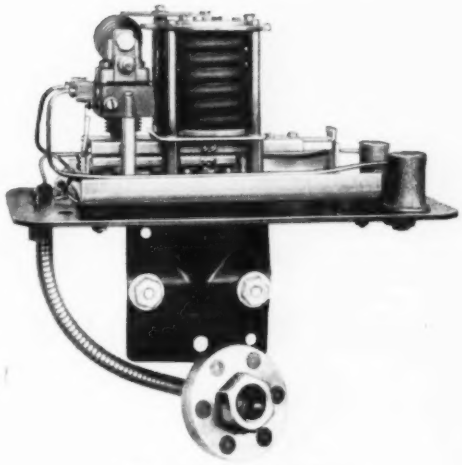
1. DYNAMIC ACCURACY—which means the accuracy of an instrument in measuring changing or dynamic conditions. TRANSAIRE Dynamic Accuracy is unparalleled. Solves the problem of process engineers who realize that an instrument accurate to a fraction of a degree in measuring static conditions can be in error by many degrees when temperature is changing.

2. DYNAMIC COMPENSATION—which means ability to compensate for inherent lags both in measuring system and rate of heat transfer of process medium. TRANSAIRE does this by introducing derivative action (Speed-Act) into *measuring* circuit. The result is Dynamic Accuracy, with a speed of response seldom thought possible, permitting much closer automatic temperature control.

TRANSAIRE is the first step in Taylor's TRANSET* Control System. Step No. 2 is either Taylor's three-response TRI-ACT* Controller, or the lower cost, BI-ACT* Controller which gives stability with one adjustment. Step No. 3 is the Taylor TRANSET Recorder or Indicator. All three combine into the famous Taylor TRANSET Control System. **Write for Bulletin 98097.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, humidity, flow, liquid level, load, speed and density.

*Trade Mark



PRESSURE:

Taylor TRANSAIRE Pressure Transmitter with narrow range spans lets you measure and transmit minute pressure changes up to 1000 feet. Works on simple force-balance principle. Accurate to $\frac{1}{2}\%$ of the selected short range span (*conventional devices are only accurate up to* $\frac{1}{2}\%$ *of upper range limit*). Sensitive to pressure changes of $\frac{1}{2}$" water. Here's accuracy and sensitivity never before thought possible in measuring process pressures—plus the convenience of suppressed ranges at high pressure levels.

THREE IMPORTANT ADVANTAGES:

1. Range spans of 20 and 10 psi available throughout range limits of 35 to 115 psia.

2. Volumetric type pressure system is extremely accurate, practically clog-proof, has corrosion-resistant 316 stainless steel diaphragm.

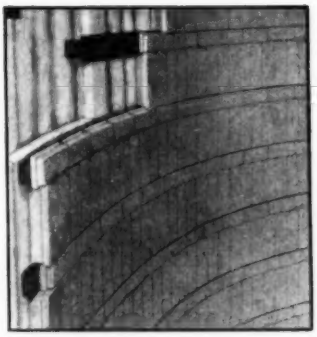
3. Temperature and barometric compensation for higher accuracy of measurement and control.

Taylor's Centennial ACCURACY FIRST SINCE 1851

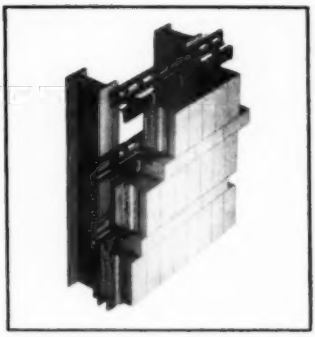
Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

(*To obtain more data on advertised products see page* 908)

Thin refractory walls—backed up with insulation—cut the costs of oil still installations. When tile are shaded by tubes, 3" walls are used; 4½" walls are specified for exposed walls of moderate temperatures.

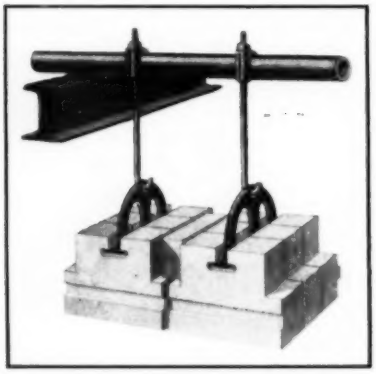


Here is a Bigelow-Liptak wall curved to fit a 25-foot diameter vessel lining. It is backed up with insulation and is hung from modified circular brackets. B-L walls and arches can follow any furnace contour.



When the going is really tough, B-L engineers select rugged 7" walls. Unit-suspended B-L walls eliminate cumulative loading and expansion. Repairs are to damaged tile, adjacent areas are untouched.

Heavy-duty B-L linings reduce oil still repairs



This pendulum-type Bigelow-Liptak arch permits the tile to swing freely in four directions. There is no cumulative loading or expansion thrusts against side walls. Arches are available in any thicknesses, follow any contour. Radial noses are similar.

Repairs are made quicker and at a much lower cost when oil stills are lined with Bigelow-Liptak walls and arches. Because heavy-duty refractories and insulation are used throughout, B-L linings stand up under the toughest of operating conditions.

Refinery boilers are enclosed with special applications of the same type of construction outlined above. When tubes are closely spaced, Bigelow-Liptak's new tube-supported wall is used. Both oil stills and boilers are covered with B-L's casing—TEXAD*. This new covering method is weatherproof, looks better, and replaces steel plate.

Catalogs describing refinery furnaces, the tube-supported wall, and TEXAD* are available upon request. Write today.

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Up from Lake Charles...with Cities Service!

For the past decade, during Cities Service's wide and rapid expansion of its petroleum processing facilities, Kellogg has worked closely with this refiner in the design and construction of several vast undertakings.

First job was a mammoth refinery at Lake Charles, Louisiana. The first complete modern refinery to be built from the ground up, it included three catalytic crackers...and alkylation, deasphalting and crude topping units as well as all plant-site facilities. Concurrently, a butadiene plant was built on an adjacent site.

Immediately following World War II, Kellogg undertook the complete modernization of the Cities Service East Chicago 35,000 BPD refinery . . . engineering and constructing new Fluid catalytic cracking, delayed coking and light ends fractionating units as well as revamping other facilities.

Today sees Kellogg at Ponca City for Cities Service. It is another major modernization job with Fluid catalytic cracking as the principal new process.

THE M. W. KELLOGG COMPANY

A SUBSIDIARY OF PULLMAN INCORPORATED

for fifty years an integral part of processing history

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Portrait at

This year is Kellogg's fiftieth of service to industry. At this time naturally, as a group of men—known collectively to the modern business world as The M. W. Kellogg Company—we can think back nostalgically. We can remember the chimney stacks

"Firm Foundation for Every Task"

Camera "portraits" of M. W. Kellogg today, appearing in preceding issues of this publication, have reviewed the research, development, process design and design engineering phases of the Kellogg operation.

This month, the camera looks at the vital task of collecting, evaluating and disseminating Technical Data and Standards . . . and then indicates how this basic work influences Procurement practice and efficiency.

1. *THE PRACTICE OF ENGINEERING* is similar to most professional operations . . . highly individual in its approach to problems. But unless *the best* of each engineer's approach is captured for the benefit of others, much individual effort would be repeated on the same problems. Thus, at Kellogg, there is a special *Standards Group* . . . engineers, whose sole function is to record the best methods for solving many problems.

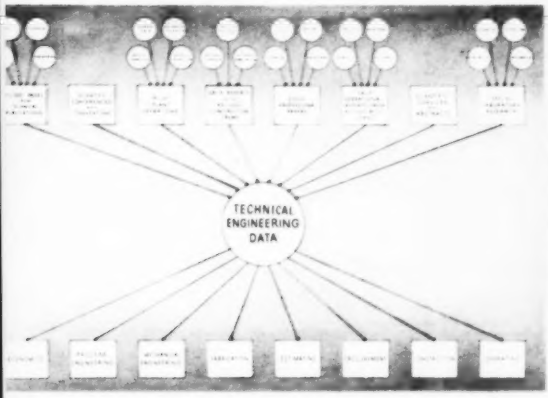
4. *CONSTANT CHECKING* and re-checking of design specifications is the responsibility of all Kellogg engineers who regularly visit operating units. Such visits are scheduled when possible for turn around periods so that the company's engineers can inspect process equipment and personally observe how Kellogg design stands up in actual practice.

5. *DESIGN STANDARDS* and detailed specifications are obviously most important in the design function of the company. But they also contribute greatly to the efficiency of such a major function as *Procurement*. Kellogg's procurement force is a large one, issuing more than 60,000 purchase orders a year, on the average. The availability of detailed specs on all items regularly purchased speeds the procurement job measurably.

Fifty... no. 7

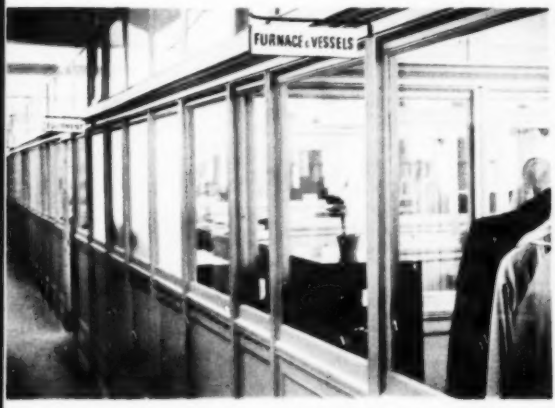
KELLOGG
1901 1951
50th Anniversary

we built in 1901 . . . the first crude vessels for oil refiners in the 'teens . . . our first combination unit. The forty-odd Fluid cat crackers built in these years. But, after all, The M. W. Kellogg Company is only a factor as it is able to serve industry today. For that reason, we are presenting this series of monthly camera studies which document our belief that a truly integrated organization can better serve industry to achieve greater earning power. This is No. 7 in the series.



2. *THESE BEST METHODS* are then made available to the entire engineering organization in the form of "Standards." Kellogg design standards, of course, embrace recognized codes, but they also project and amplify the codes for more efficient engineering and operation. Another group of engineers, with a supporting staff, specialize exclusively in the gathering, evaluation and dissemination of *Technical Data*.

3. *THIS SIX VOLUME SET* is literally priceless. While it includes much information that is available to the entire engineering fraternity, it also includes much more that is exclusive. It contains Kellogg's own research and development data, *plus* the summarized analyses of operating data from the more than 450 process units designed by the company during modern processing history.



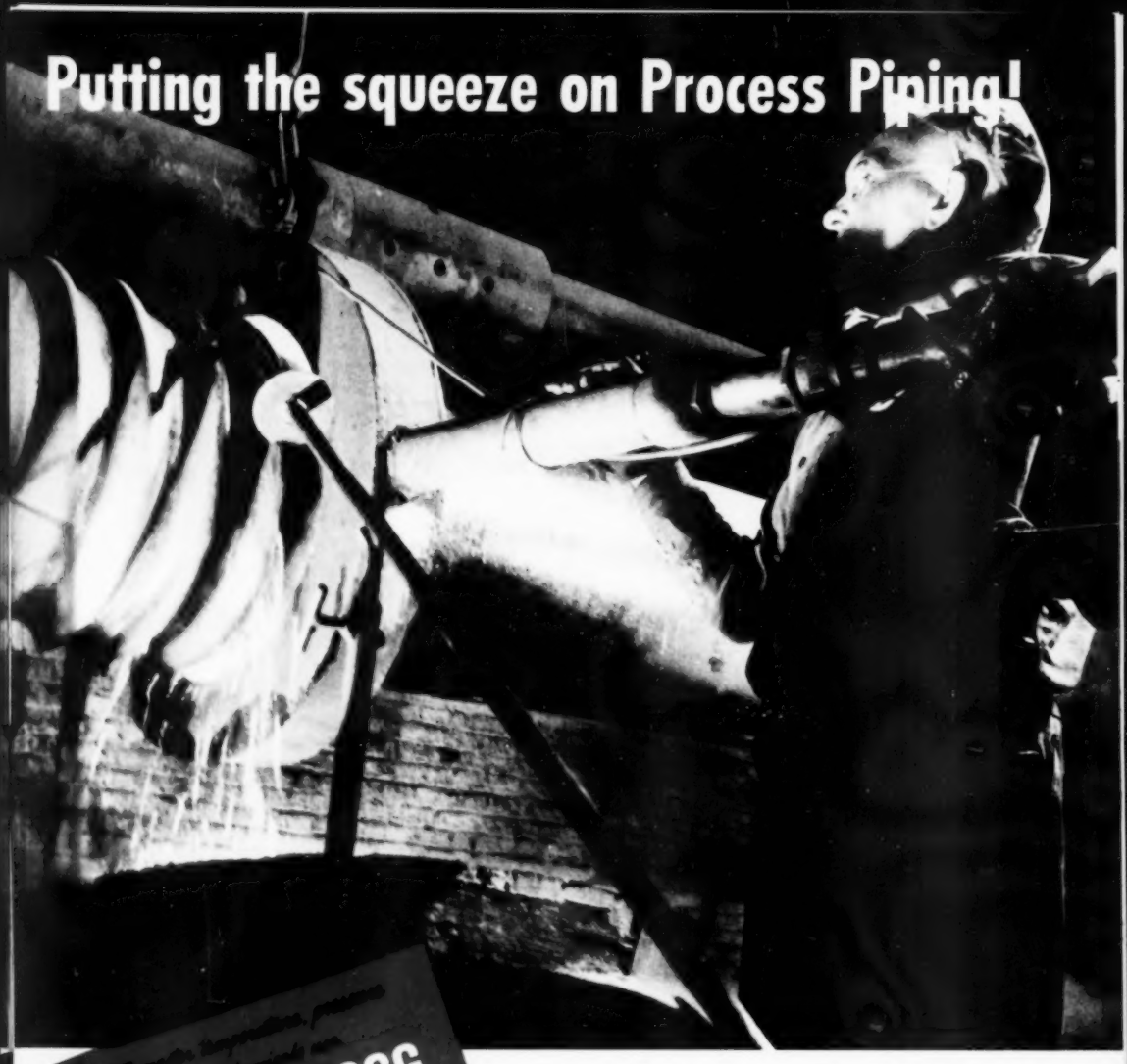
6. *ORGANIZATION OF THE PROCUREMENT GROUP* closely parallels that of the Engineering Departments. Buyers specialize in specific phases such as vessels, equipment, instruments, etc., and in classes of materials and services. Thus, each specialized buyer has the direct support of the technical knowledge of the *matching* engineering group.

7. *KELLOGG PURCHASING SPECIALISTS*, because of their close integration within a complete engineering fabricating contracting organization, are in an advantageous position to weigh delivery dates against price. Correct decisions between these factors are particularly important when they govern the starting date of plant *earning power*. Worldwide facilities also speed procurement and consequently project completion dates.

NEXT MONTH

. . . in the eighth in this series of camera studies of M. W. Kellogg today . . . you will see how Kellogg's original bent for manufacturing serves the company today in meeting engineers' toughest "specs".

Putting the squeeze on Process Piping!



This special machine put the squeeze on the first 30" O.D., chrome-moly piping to be successfully corrugated. The Kellogg technique of incremental heating and working employed in this operation has many other advantageous applications in fabrication of refinery equipment.

M. W. KELLOGG

Pressure Vessels
Vacuum Vessels
Fractionating Columns
Drums and Shells
Heat Exchangers
Process Piping
Hi-pressure—Hi-temp
Power Piping
Bends and Headers
Giant One-Piece Bends
Forged and
Welded Fittings
Radial Brick Chimneys

Special Studies of unusual problems such as stress corrosion and graphitization to assure long life and low maintenance.

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Top Welding Performance in shops and in the field by welders accustomed to working under X-ray checks.

Metallurgical Research by recognized specialists who have made major contributions in this field.

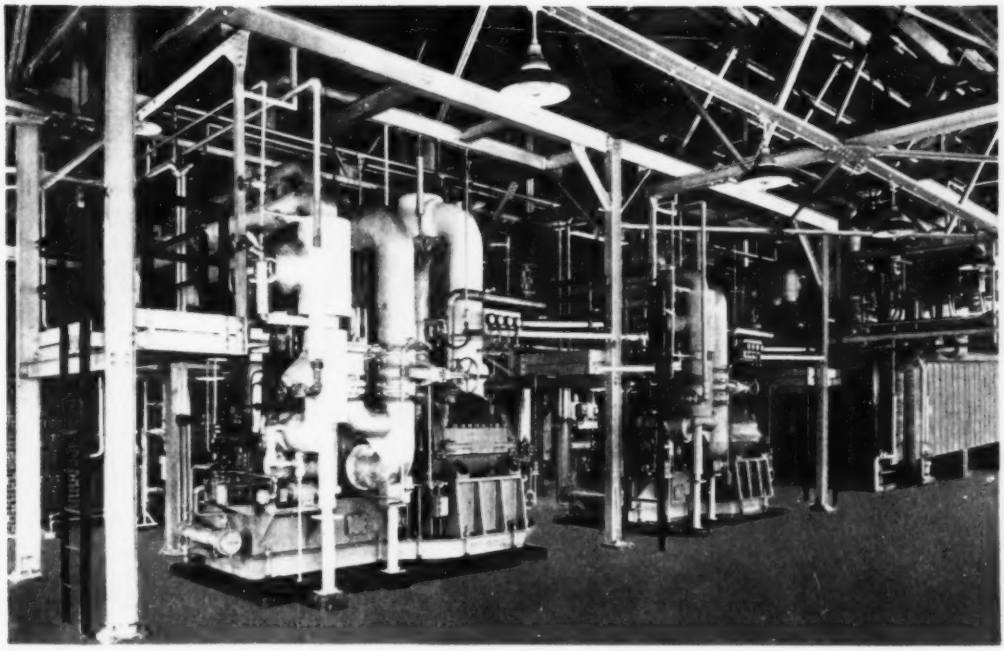
Complete Facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Rigid Quality Control devised by specialists, including chemical and micro analyses as well as mechanical and non-destructive testing.

NEWS FOR OPERATORS IN WESTERN CANADA

Canadian Kellogg Company has established complete shop facilities for the fabrication of all types of piping at EDMONTON in Alberta Province. Inquire directly or through any Kellogg office.

The M. W. Kellogg Company *(A Subsidiary of Pullman Incorporated)* **New York, Jersey City, Los Angeles, Tulsa, Houston, Toronto, London, Paris**



Two Worthington centrifugal compressors, each capable of handling the full 380-ton load; at right, one of the three Worthington chilling machines.

How Socony-Vacuum Gives Wax the Cold Shoulder

For the new addition to its Paulsboro refinery, Socony-Vacuum and its process engineers and constructors, E. B. Badger & Sons Co., found the *right* chilling equipment in Worthington's complete line.

Here's how this modern plant meets the 380-ton refrigeration load required by its solvent dewaxing process.

Plant propane is alternately condensed and vaporized in a closed cycle. The liquid propane, boiling at a low pressure and a constant temperature of minus 25F, surrounds the tubes in the Worthington inclined chiller through which the wax-bearing mixture is pumped.

Propane vapor, released in the chiller, is withdrawn to be compressed, with two liquid intercooling stages, from suction conditions of about 8 psig to a condenser pressure of 215 psig.

The compressors are four-stage Worthington centrifugal compressors. They are driven by 8420 rpm Worthington steam turbines which take steam from the plant mains at about 400 psig and exhaust at 40 psig back pressure to be used for heating purposes in other parts of the solvent recovery process.

Important installations such as this one are most likely to include Worthington refrigeration, because Worthington offers complete cycles for petroleum, chemical and petro-chemical applications, including centrifugal charge gas compressors for high pressure, condensers, coolers and exchangers.

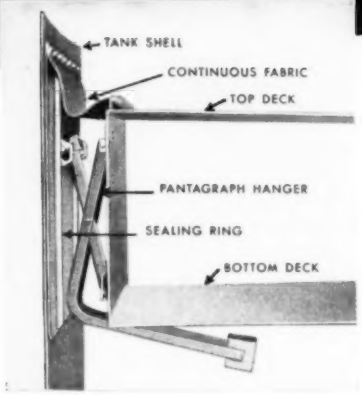
Take advantage of the *more worth in Worthington*. Write for bulletin to Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, New Jersey.

A-1-43

WORTHINGTON

THE ONLY COMPLETE LINE...ALWAYS THE CORRECT RECOMMENDATION

THE HORTON SEAL



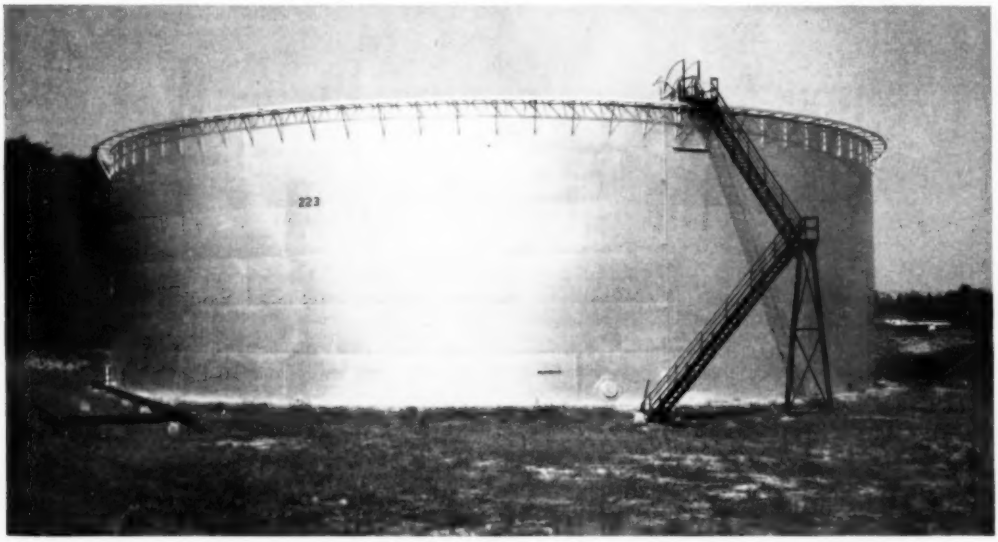
Cutaway view showing the operation of the Horton Seal. Notice the effective closure with a minimum number of parts. This means longer —trouble free life.

closely guards your storage profits

With evaporation losses a constant threat to *hydrocarbons* —it's extremely important to incorporate the most modern protective measures to assure their profitable storage. That's why many refineries—tank farms—and pipe line stations throughout the country have standardized on Horton Floating Roofs.

One feature of the Horton Floating Roof that assures superior protection against evaporation is the Horton Seal. This proven device efficiently closes the space between the roof and the shell of the tank—minimizing evaporation—yet allowing complete freedom of operation.

The Horton Seal is a standard construction on all three types of Horton Floating Roofs—Pan—Pontoon—and Double Deck. For more information, write or call our nearest office listed below.



CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Atlanta 3	2103 Healey Building	Detroit 26	1532 Lafayette Building	Salt Lake City 4	530 West 17th South Street
Birmingham 1	1527 North Fiftieth Street	Houston 2	2130 National Standard Building	San Francisco 4	1559–200 Bush Street
Boston 10	1029-201 Devonshire Street	Los Angeles 17	1526 General Petroleum Building	Seattle 1	1330 Henry Building
Chicago 4	2114 McCormick Building	New York 6	3310–165 Broadway Building	Tulsa 3	1620 Hunt Building
Cleveland 15	2215 Guildhall Building	Philadelphia 3	1630–1700 Walnut St. Building	Washington 6, D. C.	1135 Cafritz Building

REPRESENTATIVES AND LICENSEES

Horton Steel Works, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348 Caracas, Venezuela
Compagnia Tecnica Industrie Petroli, Rome, Italy
Whessoe Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Comprimo N. V., Amsterdam-O, Netherlands
Sociedade Chibridge de Construccoes Ltda., Av. Franklin Roosevelt, 194-S/704-C, Rio de Janeiro, Brazil

(To obtain more data on advertised products see page 908)

NEW TRANE BRAZED ALUMINUM SURFACE

MORE HEAT TRANSFER EFFICIENCY

in **1/4** the space

with **1/3** the weight

at **1/2** the cost

A Smaller Unit Can Do A Bigger Job

More heat transfer from every cubic foot of space, more Btu's from every pound of surface, more Btu's per dollar—with the new Trane Brazed Aluminum Heat Transfer Surface.

Many of these Brazed Aluminum Units can pack *450 square feet* of heat transfer surface—working surface—into *one cubic foot*. That's up to *nine times* more surface than a shell-and-tube unit with ¾" tube can put into the same space.

In a given space, the units can meet practically any specifications of heat transfer, pressure drop, volume, number and direction of passes, and fluid velocity.

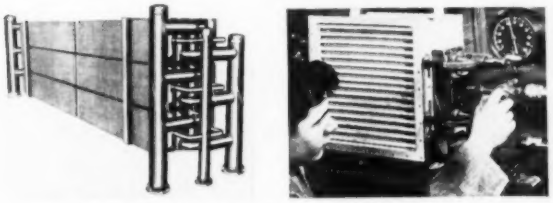
All aluminum, the units are much lighter than shell-and-tube heat exchangers—often needing only ¼ the weight to do the same job.

The units handle as many as five liquid or gas streams at once. Headers can be designed for any job.

Trane Brazed Aluminum Surface, evenly brazed in an exclusive flux bath process, is as rugged as it is flexible—it takes test pressures up to 1,000 lbs. per square inch, temperatures from −300°F. to 500°F.

Because they pack so much heat exchange surface into every cubic foot, and because of advanced manufacturing techniques, the units are much less costly than conventional equipment—a smaller unit can do a bigger job. *Trane Brazed Aluminum Units can often do the same heat transfer job as tubular exchangers that cost two or three times more.*

If you have a heat transfer job—one that demands a large number of units—Trane Brazed Aluminum Surface may be the answer. Contact your nearest Trane sales office, or write direct.

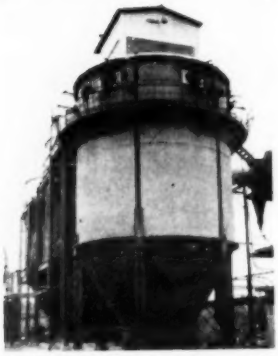


Large units—left, or small—at right, flexible Trane Brazed Aluminum Surface provides heat transfer efficiency.

THE TRANE COMPANY, LA CROSSE, WISCONSIN
Eastern Mfg. Division . . . Scranton, Pennsylvania
Trane Company of Canada, Ltd. . . . . Toronto
OFFICES IN 80 U. S. AND 14 CANADIAN CITIES

TRANE

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT



Service based on Production ... Cyanamid's plants at Ft. Worth, Texas, and Michigan City, Indiana, offer prompt service to all refining areas.

Service based on Research ... endless laboratory work helps develop catalysts suited to each refiner's needs.

Service based on Experience ... Cyanamid's knowledge of the refining industry forms the basis for sound judgment in helping customers solve their catalyst problems.

Cyanamid Service . . .

Cyanamid's technical service for the users of AEROCAT® Synthetic Fluid Cracking Catalysts is more than just files, reports, and slide rules. Much more. It represents a group of experts who are intimately acquainted with refinery operation and know fluid catalysts backwards and forwards.

With these men, it's what you *can't see* in their brief cases that's most important—knowledge, vision, and the ability to follow your problem through to its solution.

Backing this personal service is Cyanamid's long record of plant expansion and catalyst improvement to meet the petroleum industry's needs:

1942... Cyanamid starts production of synthetic fluid cracking catalysts at Ft. Worth to help refiners meet the demand for high octane fuel.

1946... Cyanamid expands Ft. Worth plant.

1946... Cyanamid becomes the *first* company to manufacture microspheroidal cracking catalysts on a commercial scale.

1948... Cyanamid expands production of MS catalyst at Ft. Worth in anticipation of growing demands.

1951... Cyanamid builds new MS plant at Michigan City, Indiana, as refining demands continue to grow.

Shortcut to "Cat" Cracking Efficiency

Vision, Experience, Facilities, Service... is the combination that enables Cyanamid to produce better chemicals for the petroleum industry: AEROLUBE® Additives for motor oils... AERO* Specialty Catalysts for chemical processes... Gasoline Dyes and Drilling Mud Chemicals. To learn more about these products and how they can help you...

send today for samples and literature.

*Trade-mark

Catalyst
When ∧ Performance Counts...
Call on Cyanamid

AMERICAN *Cyanamid* COMPANY
PETROLEUM CHEMICALS DEPARTMENT, DIV. PP8
30 Rockefeller Plaza, New York 20, N. Y.
In Canada: North American Cyanamid Limited, Toronto and Montreal

Who's the big wheel in gas compressors?

That depends on who you're listening to.

But these are facts.

Carrier Corporation has been making multi-stage centrifugal compressors for 30 years.

Our total production to date is over 2000 machines.

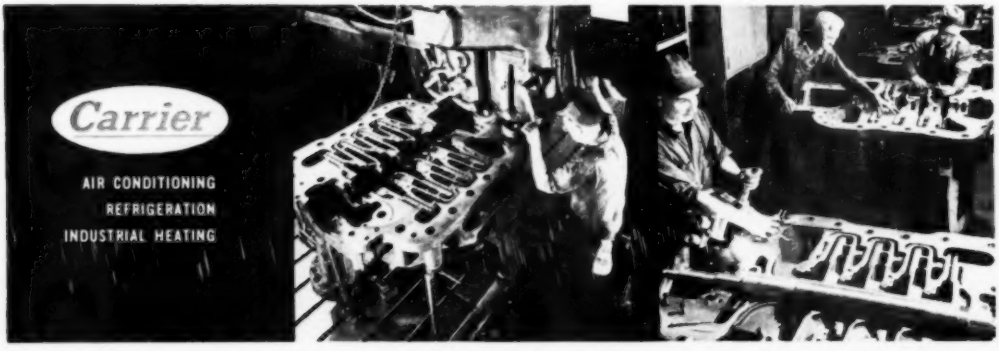
We don't know of any other company who's made nearly as many.

Those are facts . . . and you can't argue with them.

Of course, we think that the reason we've made so many compressors is that we make the best compressor.

That you may not agree with . . . until you've owned one.

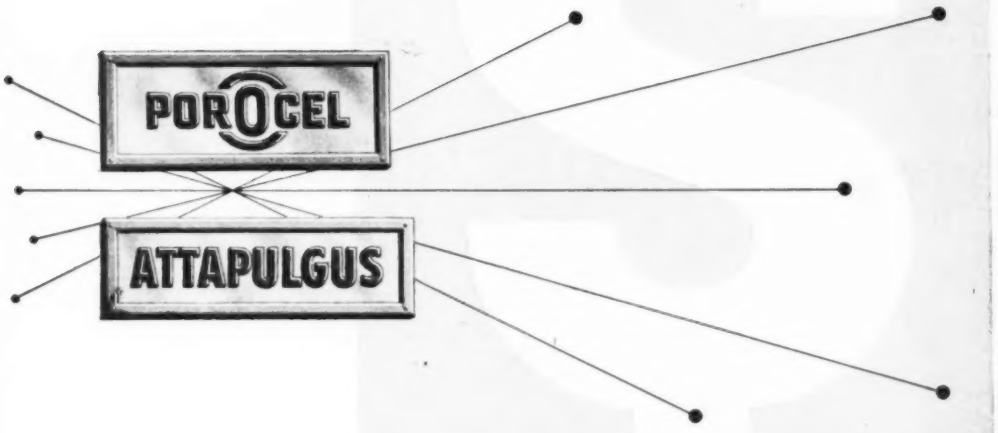
For more facts, write Carrier Corporation, Syracuse 1, N. Y.



Modern equipment and manufacturing techniques help make Carrier the big wheel in gas compressors.

Many of the men who built the first Carrier Compressor 30 years ago are still building them today.

SMALL CAUSE... BIG EFFECT



Here's an interesting case of small cause—big effect! "Small cause" is the inexpensiveness of Attapulgus Fullers Earths and Porocel Activated Bauxites. "Big effect" is the large number and intrinsic value of jobs these materials do for petroleum refiners.

From the lightest hydrocarbons down to the heaviest lube and wax fractions, many of the finished products have received treatment by these sorptive minerals somewhere along the line. Odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates are removed or converted; various reactions are catalyzed.

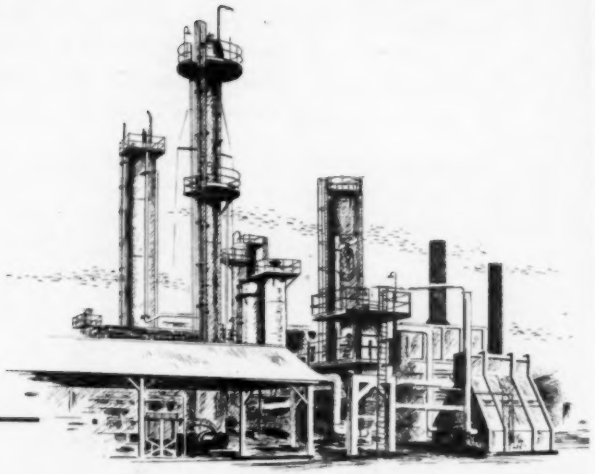
Most important, all these applications pay off. Attapulgus and Porocel adsorbents cost as little as one cent a pound. But each pound, properly applied to petroleum stocks, increases the value of these stocks by at least one dollar—a return of 100 to 1.

So let's get together on your plans to improve quality, expand output, or both. You know a lot about the techniques involved in these processes; our engineers have made many important contributions to adsorbent technology. A blending of these two funds of knowledge should produce optimum results.

ATTAPULGUS CLAY COMPANY *Fullers Earth* • **POROCEL CORPORATION** *Activated Bauxites*

Dept. D, 210 West Washington Square, Philadelphia 5, Pa.

UOP PLATFORMING UNIT for .



. . STANDARD OIL COMPANY OF CALIFORNIA

Standard Oil Company of California is installing a 10,000 b/d UOP Platforming Unit at their El Segundo refinery in response to the urgent defense requirements for increased production of benzene and toluene.

This Platformer, when constructed and placed on stream, will economically and efficiently fulfill about 15% of the increase in production of these aromatics which was requested of the industry by the Petroleum Administration for Defense.

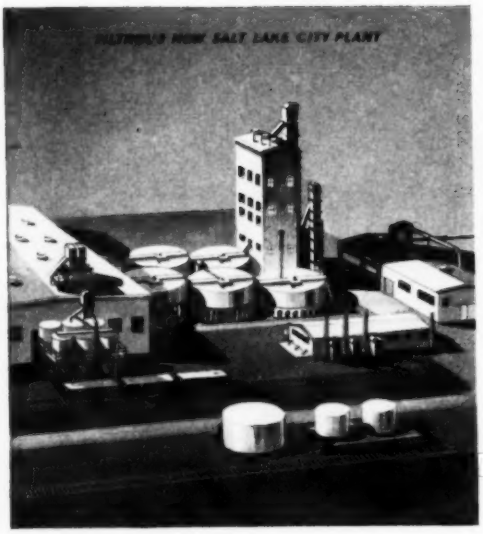
Standard's Platforming Unit has been designed to operate on a "blocked out" basis, which enables it to be rapidly converted from aromatics to motor fuel operation. This versatility is still another reason why Universal's Platforming Process has met with such ready acceptance by refiners throughout the world.

UNIVERSAL OIL PRODUCTS COMPANY

General Offices: 310 S. MICHIGAN AVE., CHICAGO 4, ILL., U.S.A.
Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Refinery

The market belongs to the refiner who serves it best



More Filtrol* catalyst available...

TO MEET THE GROWING DEMAND FOR FILTROL CRACKING CATALYSTS, FILTROL CORPORATION HAS COMPLETED A NEW PLANT AT SALT LAKE CITY FOR PRODUCTION OF CATALYSTS.

THESE NEW PRODUCTION FACILITIES SUPPLEMENT FILTROL'S OTHER PLANTS AND GREATLY INCREASE THE AVAILABILITY OF EFFICIENT, LOW COST CATALYSTS FOR REFINERS EVERYWHERE.

OTHER
REASONS FOR USING
FILTROL CATALYSTS

1. HIGHER OCTANE BARRELS
2. HIGH BUTYLENE YIELD
3. LOW COST
4. SULPHUR RESISTANT CATALYSTS
5. FASTER REGENERATION RATE
6. LOW ATTRITION RATE
7. TECHNICAL SERVICE
8. UNIFORMITY
9. LOWERED EXCESS BUTANE

FILTROL CORPORATION

OFFICES: 727 WEST SEVENTH ST., LOS ANGELES 17, CALIFORNIA
PLANTS: VERNON, CALIF.; SALT LAKE CITY, UTAH; JACKSON, MISS.

Filtrol

CATALYSTS AND ADSORBENTS

*T. M. REG. U.S. PAT. OFF.

(To obtain more data on advertised products see page 908)

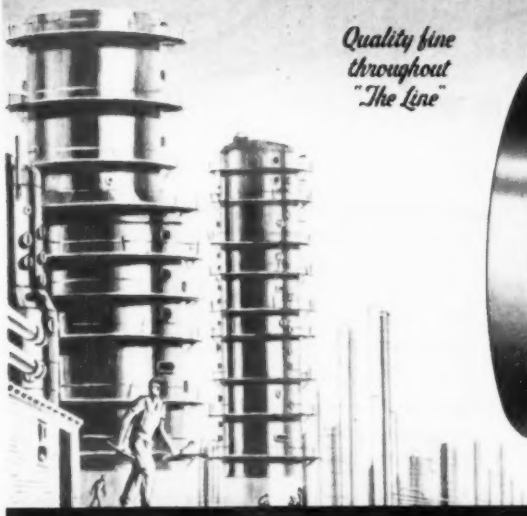
WHAT ABOUT *Wishful Thinking?*

Merely hoping a certain valve will do a required job is not enough. Maybe it will—at first. But if it's not the *right* valve in every particular—design, construction and materials—"it won't be long!"

There's a Powell Valve specially adapted to each and every flow control service. Why not always be sure with Powell?

Gate, Check, Globe and Y Valves, in Bronze, Iron, Steel and Corrosion-Resisting Metals and Alloys

Quality fine throughout "The Line"



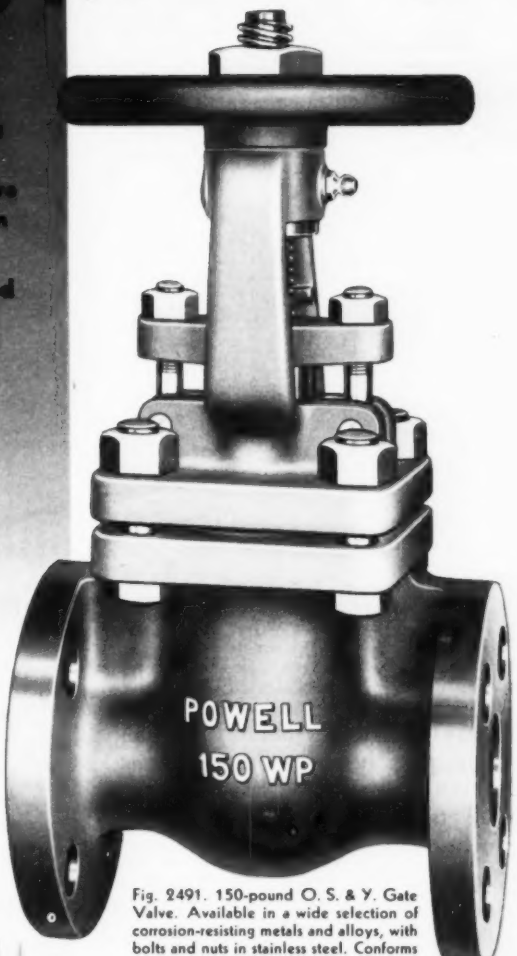
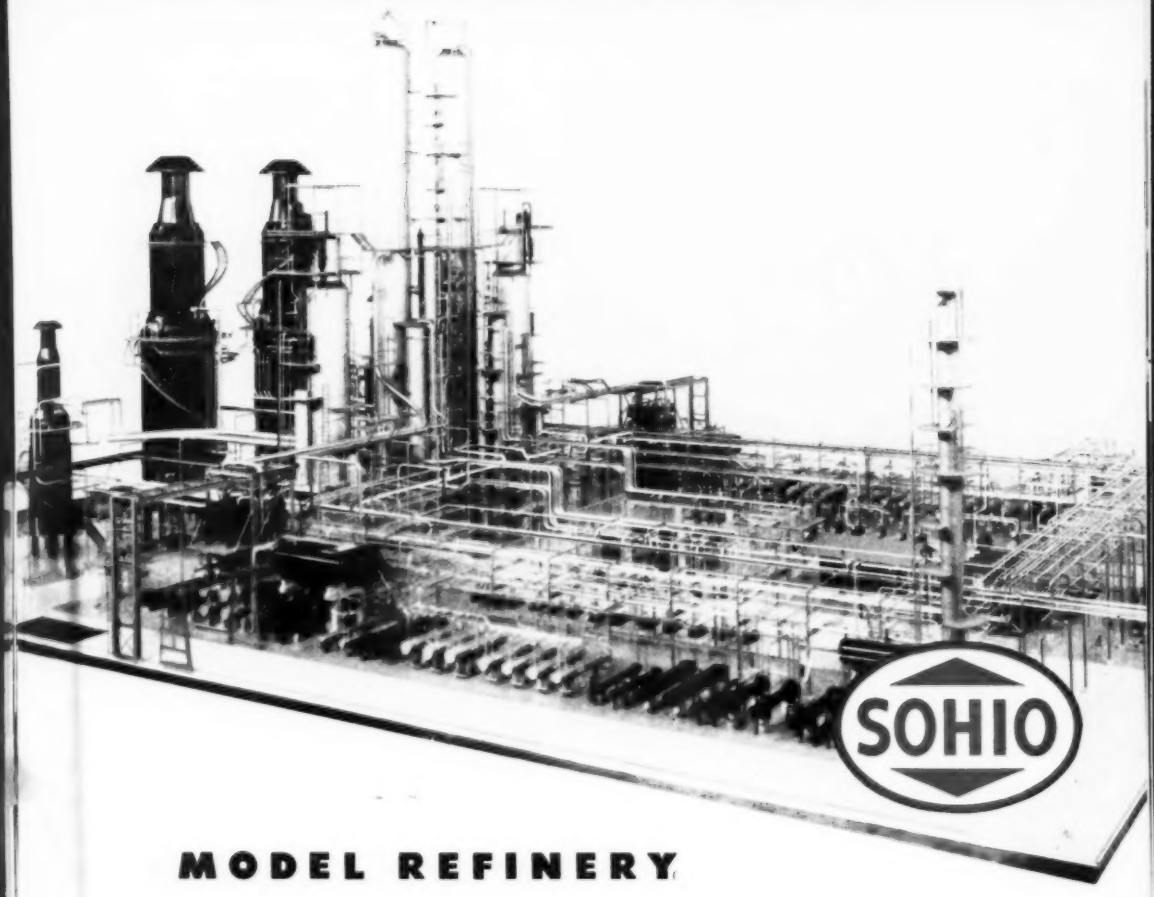


Fig. 2491. 150-pound O. S. & Y. Gate Valve. Available in a wide selection of corrosion-resisting metals and alloys, with bolts and nuts in stainless steel. Conforms to all latest standards.

POWELL

The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio



MODEL REFINERY

THIS twin combination atmospheric and vacuum unit would fit comfortably into your office. It's an accurate scale model of a 50,000 barrel unit now being built by McKee for Standard Oil Company of Ohio.

The model isn't a toy—it's a valuable engineering tool that helps check engineering and speed up construction. By enabling McKee estimators, purchasers, engineers and construction crews to see plant details in miniature it saves valuable time in interpreting plans, in instructing field personnel and in specifying and ordering materials and equipment.

For Sohio it offers the opportunity to train operating and maintenance personnel, and to set up safety procedure. In addition it is an excellent exhibit for public relations purposes.

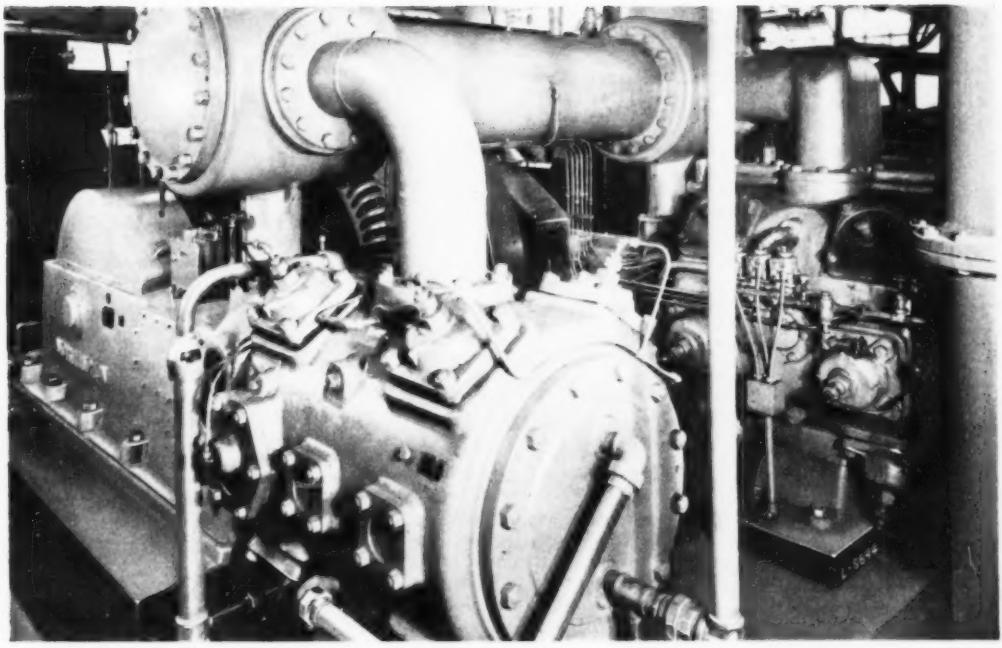
This is another example of McKee's constant effort to improve refinery design and speed construction in the field.

McKee Engineering

DESIGN, ENGINEERING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

Arthur G. McKee & Company • Established 1905

Headquarters: McKee Building, 2300 Chester Avenue, Cleveland 1, Ohio. *New York:* 30 Rockefeller Plaza, New York 20, N.Y. *Tulsa:* 918 First National Bank Building, Tulsa 3, Okla. *England:* The Iron and Steel Division of Arthur G. McKee & Company, is represented by Head, Wrightson & Co., Ltd.



Only Pennies for maintenance!

Except for replacement of a valve strip after many months of service, the Worthington Air Compressors at Standard Oil Company in Baltimore have operated two, three and four years without any maintenance expense.

Such performance proves the economy and dependability of the Worthington Air Compressor. In addition to the exclusive Worthington Feather* Valve (simplest, lightest, tightest ever built), the DC2 model illustrated above also has Worthington's own automatic variable capacity control—most accurate, flexible and simple control available. And Worthington's high-efficiency intercooler needs less water, less power, less attention.

To become familiar with the "why" of Worthington's 50-year leadership in compressors, write for bulletins on Worthington compressors. And for a wide range of equipment for the petroleum industry, ranging from pumps and engines to refrigeration equipment—investigate the *more worth in Worthington*. Worthington Pump and Machinery Corporation, Compressor Division, Buffalo, New York.

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON

*Reg. U. S. Pat. Off.

K.1.3

Amazing Properties of New Norton *Fused Stabilized Zirconia* Permit Technical Advances in Processing

None other like it! No other refractory offers such an unusual combination of properties as new Norton Fused Stabilized Zirconia.

Its *resistance to high temperature* — its *low thermal conductivity*, despite its relatively heavy weight—its great *strength* at elevated temperatures—its resistance to *oxidizing and reducing atmospheres* at high temperatures — its *chemical inertness* — and its amazing *electrical resistivity* all combine to make a refractory that promises revolutionary advances in the processing field.

For Metal Melting

For processing precious metals in high frequency induction furnaces, Norton Fused Stabilized Zirconia crucibles or cement linings are ideal because metal does not wet them. This means that you can use the same furnace interchangeably without contamination of different alloys. What's more, Fused Stabilized Zirconia permits 100% recovery of melt from furnace linings. And you can depend on it for long life. It is unaffected by operating temperatures from 3200° to 3600° F. in metal melting furnaces.

For processing ferrous alloys, too, the non-wetting property of Norton Fused Stabilized Zirconia permits its use in many pouring and melting operations.

For Chemical Processing

Fused Stabilized Zirconia is first choice on operations where excellent insulating and refractory properties are required, such as burner tunnels and furnace linings in combustion chambers. It withstands temperatures as high as 4500° F. In addition to its high temperature resistance, its low specific heat and low conductivity make it profitable on certain gas synthesis operations. Its chemical inertness also makes it valuable on certain types of processing where this property is important.

For Ceramics

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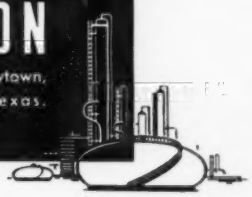

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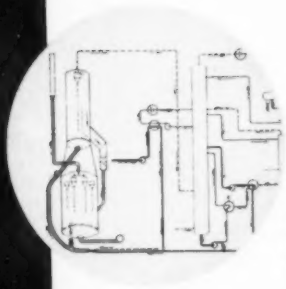

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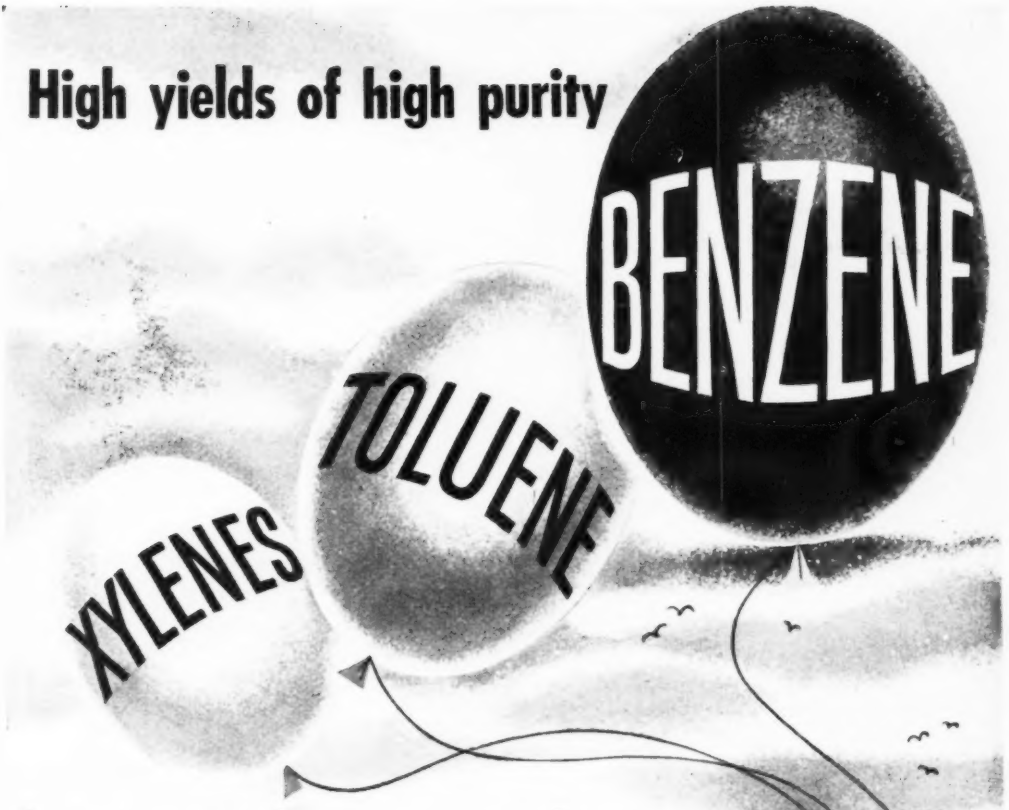

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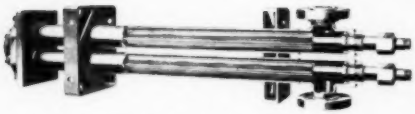

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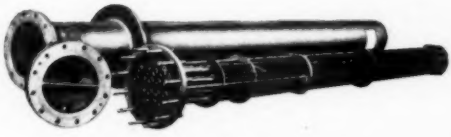

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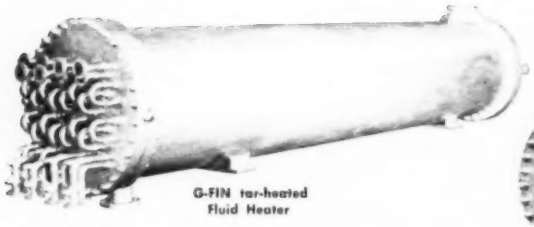

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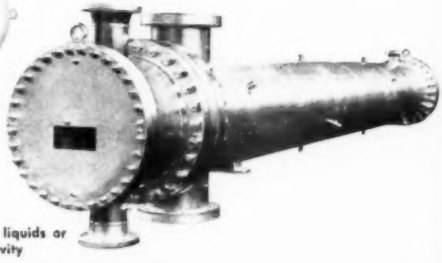

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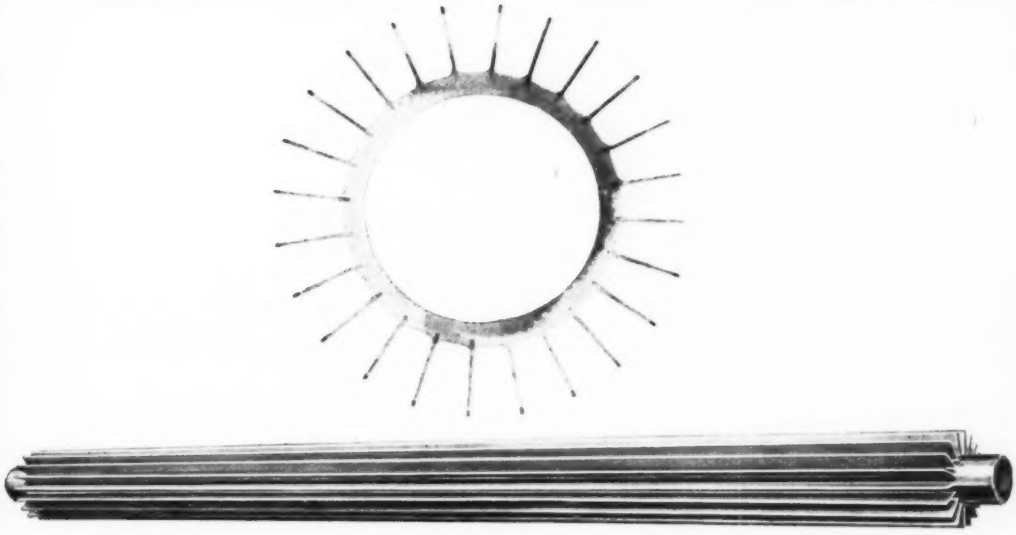

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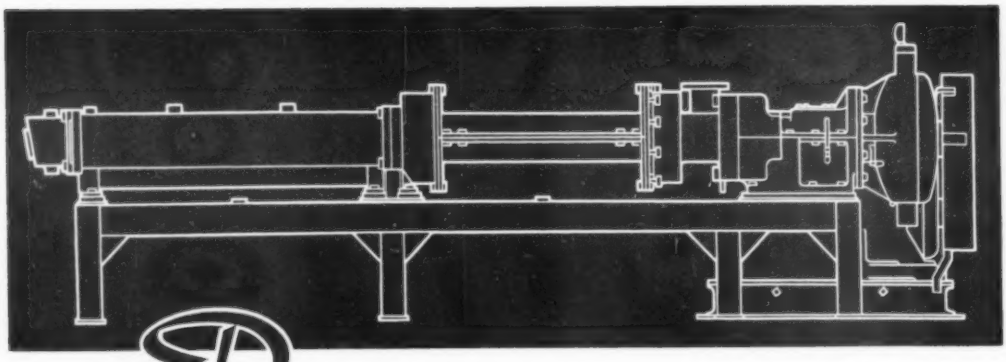

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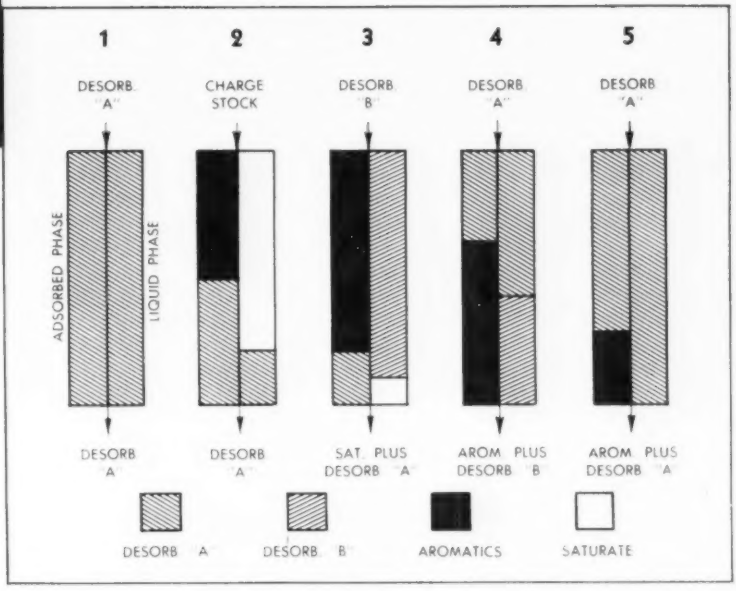


Fig. 1—Five steps in the cyclic Arosorb process

Aromatics by Adsorption

Many applications seen for Sun's new Arosorb process, which uses silica gel as adsorbent

By V. B. GUTHRIE, Editor

NEW YORK EDITORIAL BUREAU

A NEW process developed by Sun Oil Co. for separating aromatics from petroleum hydrocarbons will be incorporated in an $8,000,000 plant soon to be built at Sun's Marcus Hook refinery.

The plant will produce 13,000,000 gals./year of benzene, 30,000,000 gals. of toluene, and 15,000,000 gals. of xylenes. The benzene production alone will provide almost one-eighth of the U. S. announced requirements of over 100,000,000 gals. annually. This benzene quota must be met from petroleum sources and is over and above that now available from coal.

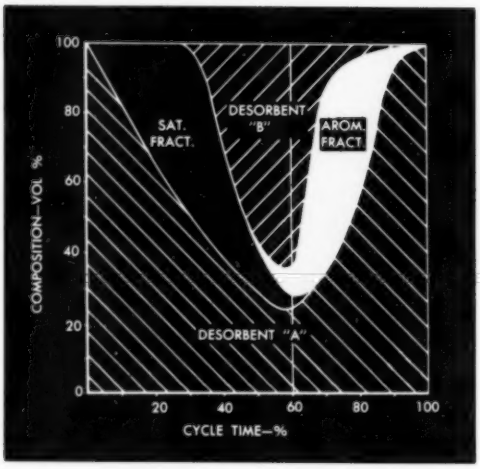
The Sun process, called "Arosorb" (a contraction of the phrase aromatic adsorption), is the first large scale commercial application of the highly selective adsorptive properties of silica gel. These properties are used both in the separation of the aromatics from the feed and in the displacement of the aromatics after they have been adsorbed on the gel. This makes the silica gel ready for the next adsorption phase in the operating cycle.

The process is a commercial development of the analytical tool of silica gel adsorption originally used in the American Petroleum Institute's Research Project No. 6, under the direction of Dr. F. D. Rossini, then with the National Bureau of Standards, Washington, now head of the Department of Chemistry, Carnegie Institute of Technology, Pittsburgh. The new process will be available to industry generally through a licensing program under Sun Oil Co. patents.

In the use of the silica gel technique in the laboratory, the gel was regenerated by heating, which sometimes destroyed its effectiveness and in some instances the gel was discarded after one use. This procedure was recognized as too costly for commercial application. The technique was first used by Sun Oil as an analytical procedure, and for eight years, research teams of chemists, physicists and engineers worked to bring the process to a commercial stage. The further application of the selective adsorptive property of the gel to displace the adsorbed material with another medium and to make the silica gel ready for the next adsorption phase, in place of using heat to purify the gel, made possible the commercial development.

Will Be Used With a Houdriformer

The flexibility of the Arosorb process is cited as one of its principal advantages. The first commercial application by Sun Oil Co. is in connection with a new Houdriforming unit, to con-



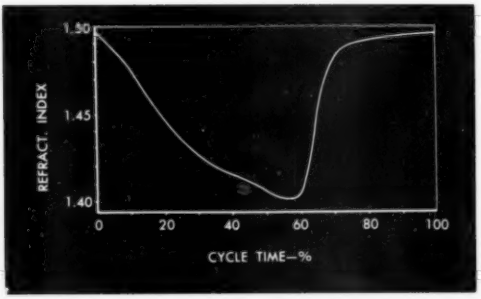


Fig. 2—Left: composition of Arosorb effluent throughout cycle

Fig. 3—Above: refractive index of Arosorb effluent during cycle

centrate and purify the aromatics to specification products.

By changing only the desorbing medium, it is claimed the same equipment can be used by the refinery for the recovery of DDT solvents and other solvents, improved furnace and diesel oils, and other products. The adsorption procedures are applicable even to materials of as high molecular weight as lubricant fractions. It is said the Arosorb unit can be installed to operate in conjunction with various conventional refining processes. Outside the petroleum industry, it can be used by the chemical and other industries for the separation of chemicals otherwise difficult to recover or purify.

The Arosorb unit to be installed at Sun Oil Co.'s Marcus Hook refinery will consist principally of six silica gel cases 10 ft. in diameter and about 20 ft. high. Each case operates independently in the cycle of adsorbing and desorbing; the cycles being staggered, however, so that the unit for all practical purposes is in continuous operation.

The design of the silica gel cases calls for carbon steel, since neither pressure nor temperature is a factor in the operation of the process, and corrosive conditions are not encountered. The six cases will contain approximately 500,000 lbs. of silica gel of a special form supplied by the Davison Chemical Corp. of Baltimore. The special type of gel was developed by Davison's research staff in cooperation with the Sun Oil Co. research department. Each case will go through 15 cycles a day, or about one every 100 minutes. A life of about one year is estimated for the gel in service.

Silica gel is described as a synthetic amorphous form of silica, with unusual effectiveness in preferentially adsorbing one type of compound from a mixture of several types. Each particle has countless micropores averaging about one ten-millionth inch in diameter. These pores offer surface area for adsorption of about 90 acres per pound. Because of size, weight or arrangement, each type of molecule in a liquid is held by the silica gel with a differing degree of tenacity. From this property is derived the term "selective adsorption."

In the Arosorb process a stream containing the desired aromatics is passed through a bed of silica gel, which retains the aromatic portion and allows the saturate portion to pass out the bottom of the bed. When the capacity of the gel for adsorption of the aromatics is reached, the feed is shut off and the silica gel bed desorbed. One of two desorbents washes out of the bed the residual saturated material from the charge stock and the other desorbent gradually desorbs or displaces the aromatics adsorbed on the gel. When desorption is substantially complete, the charge stock is readmitted and the cycle is repeated.

Five Steps in the Cycle

Fig. 1 shows the steps involved in the adsorbing and desorbing cycle. At the end of one cycle, which is the start of the next, as shown in the first vertical column at 1, the entire case is filled with desorbent "A". As indicated, this desorbent is present both in the adsorbed phase (schematically represented by the left-hand side of the diagram) and in the liquid phase (right hand side). Column 2 represents the condition at the end of the charge stock period. The adsorbed phase (left) now contains the aromatics from the feed and approximately an equal amount of desorbent "A". The liquid phase (right) is mainly the saturates present in the feed. The effluent from the case is substantially desorbent "A".

Column 3 indicates the conditions prevailing after the addition of desorbent "B", which serves principally to displace saturate material from the liquid phase. The fourth column reflects the effect of starting the addition of desorbent "A". Here the aromatics from the charge stock are being displaced from the adsorbed phase along with desorbent "B" from the liquid phase. The fifth figure shows what happens near the end of the desorption step. Almost all the aromatics from the charge have been displaced and the case is again nearly full of desorbent "A". The next step will be a complete return to the conditions prevailing in column 1, and the start of a new cycle.

In actual operation the flow through the case is continuous and there is a gradual increase and decrease of the various components in the effluent. This is pictured by the phase diagram in Fig. 2, which gives the composition of the effluent at all points throughout the cycle. In this example, the product would be diverted from the saturate effluent receiver to the aromatic receiver at approximately 60% of the cycle. Fig. 3 gives a plot of the refractive index of the effluent against per cent of cycle, to show how readily the course of the cycle may be followed and controlled by suitable instrumentation. Since the aromatic and saturate streams both contain desorbents "A" and "B", they are each sent to two distillation towers to recover the desorbents.

Fig. 4 is a flow sheet of the process approximately as it will be applied in Sun Oil Co.'s Marcus Hook refinery, with only one of the silica gel cases being shown. The feed stock and the two desorbents enter the top of the case in suitable sequence through the inlet manifold. The saturate effluent flows to a train of two distillation columns, in the

first of which desorbent "B" is removed as an overhead product and recycled. The saturate portion of the charge is recovered overhead in the second fractionator, with desorbent "B" as a bottoms which is also recycled.

The aromatic effluent is similarly handled except that, since a mixture of benzene and toluene will be processed, a third tower is added to the train to act as a benzene-toluene splitter. The precise sequence of recovery can be altered to suit the convenience of economic situation of any individual refiner.

Desorbents "A" and "B" are hydrocarbon streams having boiling points different from those of the charge stocks. In Sun's proposed plant, desorbent "A" will consist of mixed xylenes and desorbent "B" will be butane. About 2 bbls. of desorbent "A" and 0.5 bbls. of "B" will be required per bbl. of charge or, by analogy with solvent refining, a solvent dosage of 250%. However, in the Arosorb process, four-fifths of the "solvent" is taken as a bottoms product and does not need to be distilled. The above figures are for a feed containing 35% aromatics. The ratio of desorbents to charge would decrease with a lower aromatic content feed and increase with a higher aromatic feed.

In the operation of the Arosorb process, the silica gel will be protected from moisture and other poisons by regenerative, pretreatment driers on each of the streams feeding the cases. At the end of its life the gel will be discarded and replaced with fresh material. Replacement of gel can be accomplished in one case at a time, thus not destroying the continuity of the operation. Under all circumstances the recovery of available aromatics is high, but it is diminished somewhat at very high levels of aromatic purity as shown in the following:

% Purity	% Recovery
98	90
96	94
94	96
90	98

No problem is experienced in making specification benzene and toluene other than that a light sulfuric acid treatment is usually required to meet the acid wash specification. Not much acid is required as olefins, which cause off-test acid wash, are largely rejected to the saturate product in the Arosorb process.

The cyclic operation of the silica gel cases is automatically controlled. A meter in the effluent line from each case maintains the flow rate constant at any desired level. This permits the quantity of charge and of desorbents "A" and "B" to be controlled wholly by a cycle timer which also keeps the operation of the six cases staggered. Automatic cycle timers have been used in Sun Oil refineries for several years, being an important auxiliary in the operation of Houdry fixed bed catalytic cracking units.

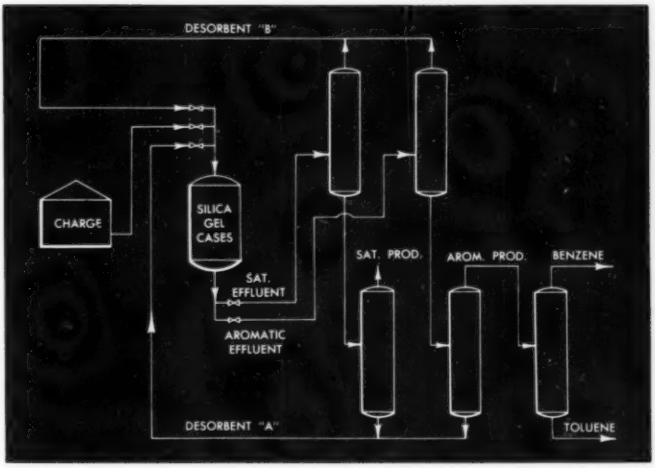


Fig. 4—Schematic flow diagram of the Arosorb process

In the Arosorb process the effluent is accurately and automatically cut from the saturate to the aromatic product line by means of a refractometer developed in the Sun Oil Co. laboratories. This instrument measures the refractive index of the effluent and is adjusted to switch the product valves at predetermined times after this measured characteristic of the effluent passes through a minimum.

Costs of an Arosorber

Investment and operating costs of an Arosorber vary with the size of the unit, the desired purity of the product, aromatic content of the feed, the manner in which the unit is integrated with other facilities and other factors. However, typical figures which include reasonable allowances for overhead, taxes, maintenance, 10-year depreciation, and so on, for a unit with a capacity of 1000 b/d of aromatics, give an investment cost of $1,200,000 and an operating cost of 6.5c gal. of aromatics. For a 2000-bbl. unit, the investment is estimated as $1,900,000 and operating cost 5c gal. of aromatics.

Although Sun Oil Co. will couple its Arosorber with a 10,000 b/d Houdriformer, any of the new catalytic reforming processes could be similarly used. The catalytic reforming operation converts naphthenes in a carefully fractionated straight-run gasoline into aromatics. Suitable redistillation of the product is used to prepare aromatic rich feed for the Arosorber. Final fractionation of the aromatic product then produces specification products.

Costs and steel requirements for the process are said to compare favorably with competitive processes on a per-bbl. of product basis. Both Houdry Process Corp. and Universal Oil Products Co. are authorized agents to license the Arosorb process under patent rights of the Sun Oil Co.

Other Work on Adsorption

California Research Corp. of Standard Oil Co. of California, in 1949 reported the development of a cyclic adsorption process for the liquid-phase separation of aromatics or olefins from saturated aliphatic hydrocarbons[1].

Commenting on their work, the investigators stated: "The early studies indicated that adsorption refining stood a good chance of being competitive with, or superior to, conventional treating processes such as SO_2, phenol, Duosol, furfural and acid treating. The results from experiments in laboratory silica gel columns showed that higher yields of raffinates of better quality were attainable by adsorption than are attainable by conventional solvent refining processes.

Extensive economic studies were made on liquid phase adsorption refining based on the cycled adsorption process for plants processing from 2000 to 15,000 b/cd of feed. The operating cost was found to be in the range of 1 to 3c/gal. of feed and the total production cost, including five-year plant payout and two-year adsorbent life, in the range of 1.5 to 4c/gal. of feed. The production cost chargeable to adsorption for the recovery of pure aromatics was said to be about 6c/gal. of aromatic.

References

(1) "Refining by Adsorption", S. Engle and J. W. Scott; PETROLEUM PROCESSING, August, 1949, pgs. 881-884.

Refining Expansion Program Growing

Total cost of DPA-approved projects to date is around $565,000,000

THE total estimated cost of oil company refining and allied projects so far approved by the Defense Production Administration for accelerated tax amortization is close to $565,000,000. And more companies are being added each week, as DPA announces approval of projects for basic refining, aviation gasoline, petrochemical, storage and other facilities needed to supply petroleum product requirements both of the armed services and of growing domestic consumption.

The present total cost figure is not far below the approximately $694,000,000 which was spent by the oil industry for new refining facilities during World War II.

All of the present projects are to be financed by the individual firms concerned. None of them will be government-built and industry-operated as was the case during the last war to the extent of an additional $233,000,000 worth of new installations.

Also, it should be pointed out that some large-scale plant construction is not being included in the DPA-approved projects. A few companies, notably Esso Standard Oil Co., are not applying for tax relief on any of their building programs, and some companies only on part of their program.

500,000 b/d New Capacity

The basic refining projects so far authorized by DPA for fast tax write-off will add more than 500,000 b/d to the country's overall crude refining capacity. However, Bruce K. Brown, Deputy Administrator of the Petroleum Administration for Defense, has stated that 1,000,000 b/d additional crude refining capacity will be needed by the end of 1953.

The total estimated cost to date of DPA approved projects for basic refining units, and for aviation gasoline plants, units for the manufacture of benzene and other aromatics, petrochemicals and other special products is over $548,000,000. Projects for building storage for gasoline, heating oils, aviation gasoline and other products, of some 50 oil companies have been approved in the amount of around $17,000,000. DPA approved projects of allied companies for manufacture of tetraethyl lead materials, catalysts and petrochemicals from natural gas and petroleum derivatives to date total around $165,000,000. Thus the total cost to date of projects of the oil companies and allied supply companies and of companies making chemicals from natural gas and petroleum raw materials, as approved by the DPA, is close to $720,000,000.

In some cases the projects included are already completed and the plants in production. While a few were started even before the Korean war was launched, the need for their facilities in the defense program was recognized and they were certified for accelerated tax amortization by DPA on the same basis as new projects. Some of the projects are already under construction. However, the volume of oil company building programs now being announced, and those still in the design stage, indicates the plant expansion period ahead will be by far the greatest in the oil industry's history.

Illustrating the broad nature of the present expansion program is the fact that a number of natural gasoline plants have been recently included in the DPA listings. The increasing production of natural gas in the southwest and the development of new oil fields and extension of others have influenced the building of gasoline and cycling plants to process these new supplies of gas. However, in the southwest much of the new construction is considered in line with anticipated requirements for natural gasoline and allied products when the nation achieves its goal of 1,000,000 b/d additional refining capacity.

Production of carbon black is on the increase, and due for further increases by the end of 1952. Recently, DPA approved 11 carbon black projects, at a total cost of over $26,000,000 for an average fast tax amortization of 60%. The capacity represented is estimated to be approximately 750,000,000 lbs. of furnace blacks annually. Their output is in large part required by the growing volume of synthetic rubber production starting in 1950.

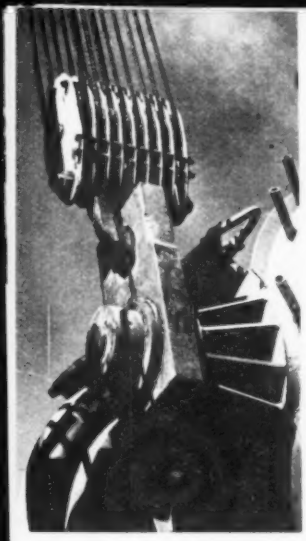
Additional Projects Listed

Accompanying table lists recent refinery and natural gasoline projects certified by DPA for fast tax amortization. These are supplementary to the listing of PAD recommended projects published in the June issue of PETROLEUM PROCESSING, pps. 607-610. These recommended projects were all approved by DPA.

Recent Refinery and Natural Gasoline Defense Plant Projects Certified by DPA for Accelerated Tax Amortization

(Supplementary to PAD Listing Published in June, 1951 issue, p. 608)

Company	Location	Estimated Cost, $	Process or Product
Acadia Corp.	Shreveport	2,907,000	Gasoline
Atlantic Refining Co.	Philadelphia	5,600,000	Cat. Reform
Eastern States Pet. Co.	Houston	3,300,000	UOP Platformer B-T-X facilities
Gulf Oil Corp.	Pittsburgh	606,486	Natural gasoline
Higgins Prod. Co.	Ulysses, Kans.	2,650,000	Gas processing
Hancock Oil Co.	Long Beach, Cal.	4,000,000	Ethylene Glycol
Leonard Refineries, Inc.	Alma, Mich.	3,109,000	Gasoline
McKamie Gas Cleaning Co.	Magnolia, Ark.	1,772,483	Gas processing for Sulfur recovery
Magnolia Petroleum Co.	Stephens Co., Texas	445,000	Natural gasoline
Ohio Oil Co.	Matagorda Co., Texas	4,108,814	Gas processing
Mid-Continent Pet. Corp.	Tulsa	817,274	Alkylation
Phillips Petroleum Co.	Brazoria Co., Texas	6,094,710	Gas processing
Phillips Petroleum Co.	Sherman Co., Texas	6,014,416	Gas processing
Phillips Petroleum Co.	Hutchinson Co., Texas	206,830	Gas processing
Pontiac Rfg. Corp.	Corpus Christi	475,000	Gas oil
Pontiac Rfg. Corp.	Corpus Christi	275,000	Gasoline
Signal Oil & Gas Co.	Long Beach, Cal.	250,000	Butane and Isobutane
Socony-Vacuum Oil Co.	Paulsboro, N. J.	911,000	Gasoline
Socony-Vacuum Oil Co.	Brooklyn	4,640,000	TCC and Cat. Poly
Socony-Vacuum Oil Co.	East Chicago	4,610,000	TCC and Cat. Poly
Shell Oil Co.	Beckham Co., Okla.	4,544,000	Elk City gasoline plant
Standard Oil Co. of Texas	Snyder, Texas	1,280,000	Gas processing
Standard Oil Co. of Texas	Kern Co., Cal.	320,000	Isobutane
Texas Nat. Gas Corp.	Jones & Fisher Co.'s, Texas	1,132,700	Gas processing
Warren Petroleum Corp.	Antioch, Okla.	1,214,684	Gas processing
Warren Petroleum Corp.	Lindsay, Texas	261,337	Gas processing
Warren Petroleum Corp.	Holliday, Texas	389,819	Gas processing



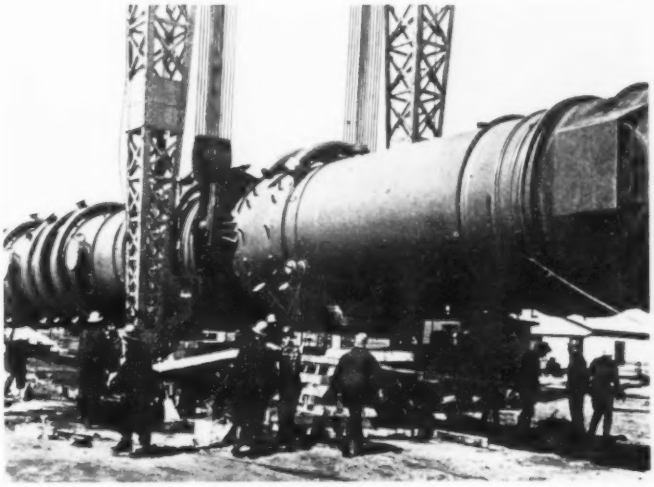
207-Ft. Hypersorber Tower Raised into Place in 2 Hrs.

By ROBERT MERIMS*
Petroleum Refining Division
Foster Wheeler Corp., New York

THE new hypersorber erected in March of this year at the Midland, Mich., plant of Dow Chemical Co. is one of the largest vessels ever lifted in a single piece. It towers 207 ft. above the ground, is 9 ft.-3 ins. in diameter and weighed 587,000 lbs. when lifted. Total weight when finished will be approximately 800,000 lbs., the additional weight being due to internals, insulation, attached platforms and so on.

The problems involved in fabricating, transporting and erecting the vessel were in many instances unusual, due to its size, and required careful design, planning and coordination on the part of the Foster Wheeler staffs. Although the vessel was raised in approximately two hours, it took many more hours of planning and arranging to prepare for the task, aside from getting the lifting equipment into position.

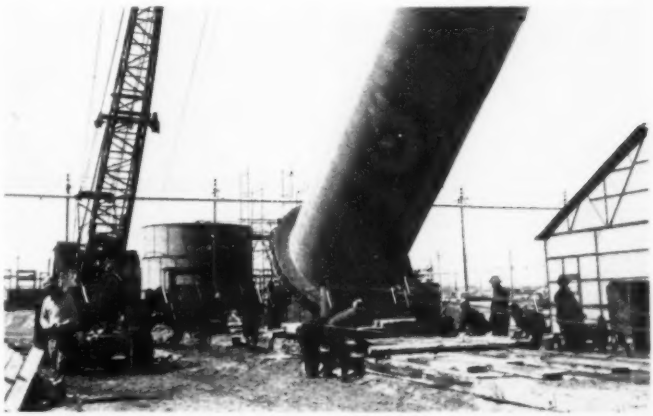
The immense size of the hypersorber vessel made it impossible to ship it in one piece from the fabricating shops. It was sent from the Carteret shops to Midland in two sections, using low slung flat freight cars having extra weight capacity. There are only 5 cars of the required type in the U.S. The upper section was shipped first mounted on three cars, the vessel being anchored to the middle car and pivoted on the two end cars. The lower section was later shipped in the same way, it being necessary to cut off one of the bustle rings, a header introducing gas into the tower, as well as a lower flange.



Ready for the "big lift." Stiffleg crane is in place and cables are fastened to tower. **Upper left corner** shows close-up of huge lifting lug

Both sections moved on the rails only during the day, as the clearances were too close to take a chance on night travel. In each case the trip from Carteret to Midland took two weeks.

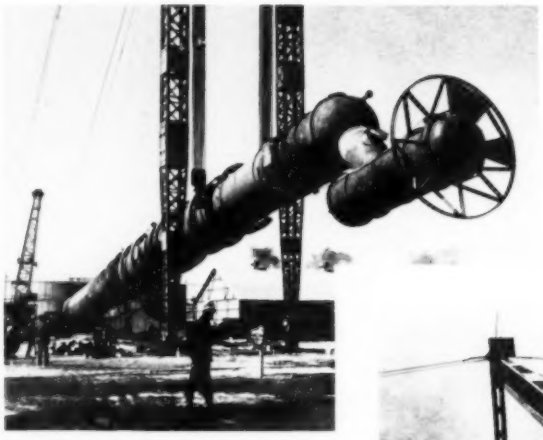
At Midland, the sections of the hypersorber tower were readied for field welding by the Austin Construction Co., who handled the erection. The first step consisted of cribbing up the vessel by putting timbers under various sections. Welders could then get underneath to make the girth weld joining the two main sections. The lift line drum was then welded to the main vessel. Because of the size and thickness of the shell, it was necessary to preheat the sections to be welded, and after



On the way. See next two pages for progressive views during erection

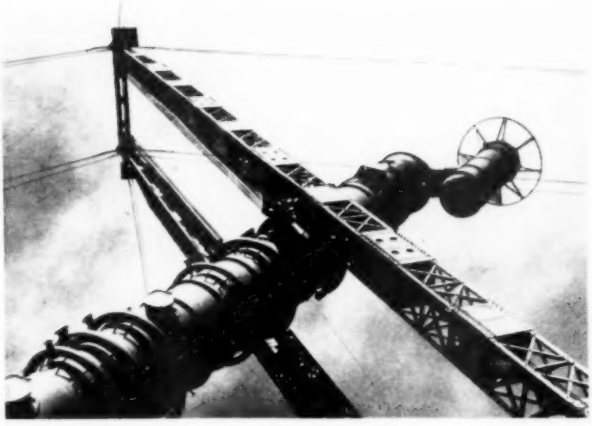
* Condensed from a report, "New Hypersorber Tower for the Dow Chemical Co.," in the June, 1951, issue of HEAT ENGINEERING, published by Foster Wheeler Corp.

Giant gallows frame for lifting the tower consisted of two 190-ft. stifflegs, each weighing 20 tons and requiring a 30-ton crane (see left background) to be raised into place themselves



Going up! Stifflegs are said to be largest in the east, and were rented from Sun Oil Co. It took two weeks to assemble and raise them due to their great height and the wind

Viewed from ground up, lifting operations looked like this at about the half-way mark



welding was completed, to stress relieve at temperatures up to 1300 F.

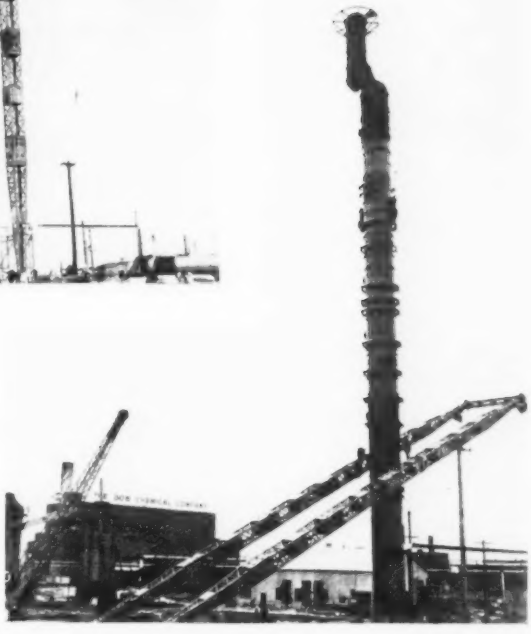
Copper tubing rather than the conventionally used nichrome wire resistors was used as an induction coil for the heating. It was wrapped around the proper section and tied into a source of alternating current in a control house. The copper wire acted as the primary coil in a transformer setup, the current from it generating the heat. Water was run through the copper coil to keep it cool. The vessel alone was heated in this manner.

The hypersorber was now ready to be lifted. Two 190-ft. stifflegs, tied together by a crossbar to form a gallows frame, were used. The legs weighed 20 tons apiece, were shipped in sections and raised by a 30-ton crane. They are the largest stifflegs in the east and were rented by Dow Chemical from the Sun Oil Co. It took two weeks to assemble and raise them due to the rigging difficulties caused by their great height and the wind. Sheared blocks from the top of the stifflegs were hooked onto the vessel lifting lugs. These lugs were so placed as to be in the upper third point of the column with regard to its center of gravity. Two hoisting engines supplied power.

Exclusive of the lift drum, the hypersorber tower was 185 ft. in height and thus could go under the crossbar. The top of the lift drum would be above the bar, however, and lifting had to be set up so it would clear the bar. If shorter stifflegs were

Almost up, tower has reached point for ticklish maneuvering by experts so gallows frame can be taken away

Tower is in place with foundations secure, thus tower itself supports the stifflegs so they can be lowered and dismantled. As installed, the column can withstand wind loadings of 25 psi. on the projected area of its cylindrical surface



THIS MONTH'S COVER . . .

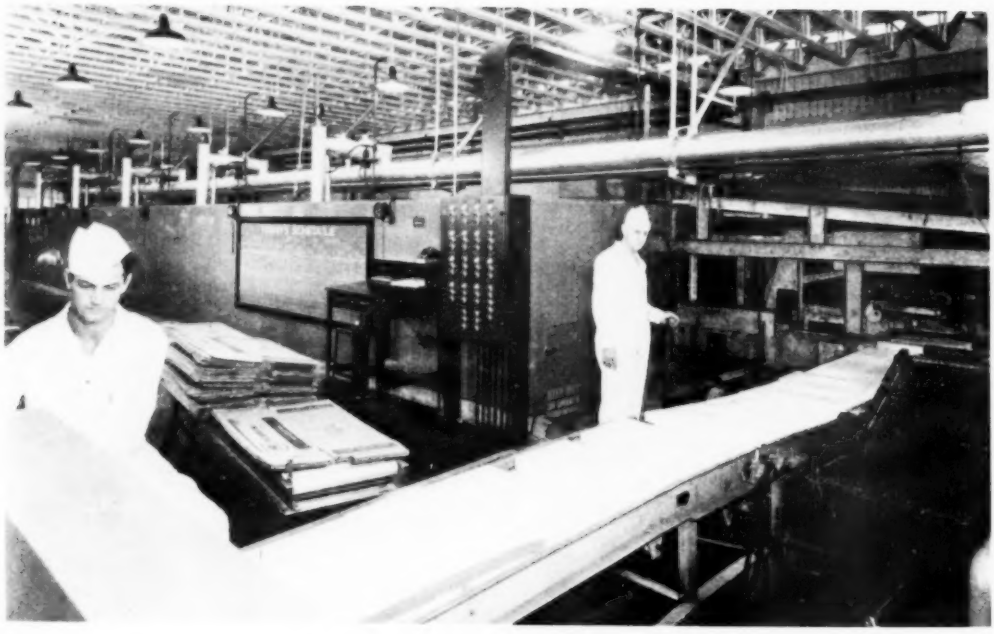
. . . shows Dow Chemical Co.'s 207-ft. tall process tower being erected at its Midland, Mich., plant. Weighing some 293 tons while being lifted into position, the tower required some careful and spectacular engineering and handling in this "big lift," the total time for which was only two hours.

used, or if the vessel were taller, it would have been necessary to replace the crossbar with guyed wires of extreme length.

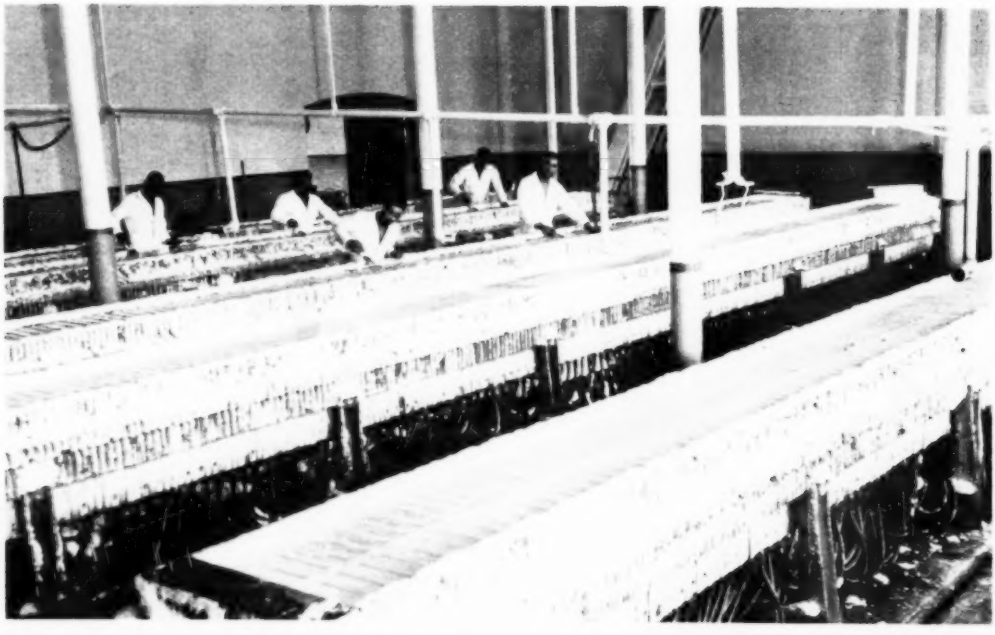
The new hypersorber unit, when operating, will take a cracker effluent and recover a sidecut stream of C_2's, a bottoms product of C_3's plus and will take off an overhead of methane and lighter. In effect, it will consist of two towers in series, one separating methane and lighter from C_2's and the other C_2's from the C_3's. Carbon is sent to the two sections via internal piping and considerations of solid flow were of the utmost importance in the design of the plant. Dow Chemical Co.'s first unit recovers ethylene from a demethanizer overhead, as has been described in previous literature(1).

References

(1) Kehde, Howard et al., *Chem. Eng. Progress*, 44.575-582 (1948); Bland, Wm. F., PETROLEUM PROCESSING, 3, 635-638 (1948).



Continous Moulding of Paraffin Wax



Replaces Older Batch Methods . . .

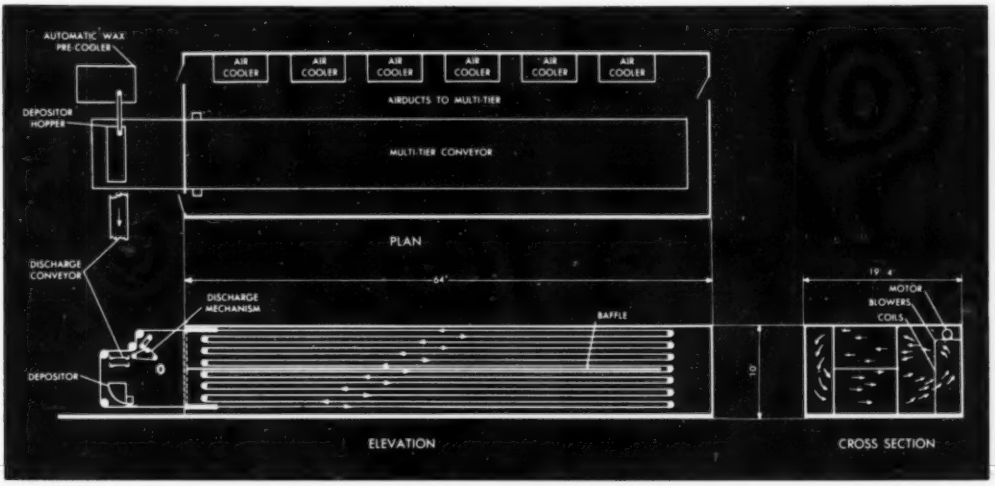


Fig. 1—Continuous wax moulder as installed at Beaumont

By L. H. JENNINGS, J. H. BEARD, and V. A. KALICHEVSKY*
Refining Division, Magnolia Petroleum Co.

MANY inherent difficulties are encountered by refineries in operating the rather primitive conventional batch wax moulding equipment. The process is slow and expensive, requiring a great deal of manual work. The cakes are often uneven and vary in weight because of the difficulty of maintaining a continuous flow of wax into the moulds during the solidification period and the presence of entrapped air. After the cakes are formed, some wax is lost in scraping off the surplus left in the pan. The necessity of scraping the wax also makes the process sloppy, and the floor area required to accommodate the equipment is comparatively large.

The shortcomings of the batch moulding process instigated work by the engineers of the Magnolia Petroleum Co. to develop improved methods for manufacturing wax cakes. After investigating similar problems in other industries, the engineers decided that the continuous chocolate moulding machine sold by the J. W. Greer Co., Cambridge, Mass., might be properly modified to offer a solution to the wax moulding problem. Through the joint efforts of the two companies, a continuous wax moulding system was built and put into operation at the Beaumont refinery of the Magnolia Petroleum Co.

The schematic flow diagram of the process, as shown in Fig. 1, reveals the simplicity of this new continuous method for moulding waxes. Here briefly is how the system works: First, molten wax kept in insulated and steam-heated charge tanks is pumped through automatically controlled "tempering" exchangers, where its temperature is adjusted somewhere between 140° and 160° F., depending upon the wax melting point. For best performance this temperature should be as low as possible, provided the wax does not begin to solidify before it reaches the cooling chamber. The tempering exchangers are designed to operate both as heaters or coolers in order to maintain an even temperature of the wax stream.

From the tempering exchangers the liquid wax is directed to the steam jacketed "depositor hopper". This hopper is an open rectangular tank with a partially sloping bottom. The wax level in the hopper is automatically regulated by controlling the speed of the charge pump. The portion of the hopper having the flat bottom contains six pistons, which act as measuring devices for the quantity of wax required to form the individual cakes. The pistons are easily adjustable, having a maximum ability to discharge 12 pounds of wax into each pan. After the pistons are set, the weight of the wax delivered into the pans remains constant and varies less than one-half of an ounce between the individual fillings.

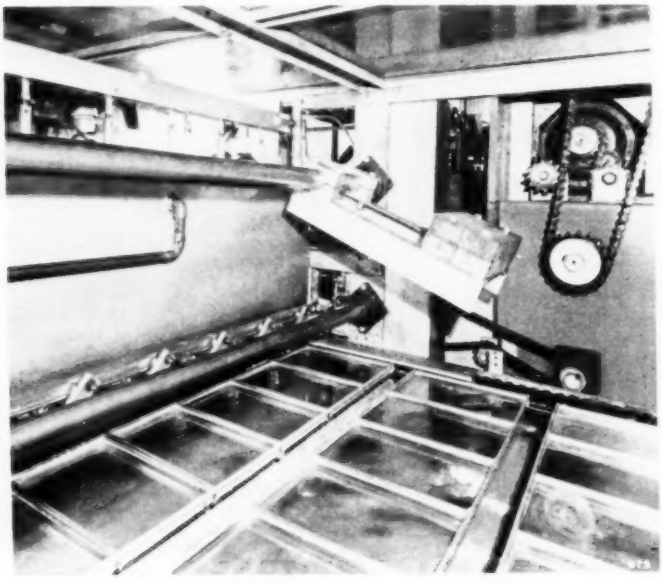
The pistons discharge the molten wax directly into the moulding pans which are 19 in. long, 11¾ in. wide and 2 in. deep. In continuous circulation are 2508 such pans. The dimensions are not critical although they are somewhat limited by the over-all equipment specifications for the individual installations. Considering the minimum permissible thickness of the wax cakes due to their brittleness, the pans of the above size can accommodate from 8 to 12 lbs. of wax. The moulding pans rest on trays which move on a chain conveyor. Each tray holds six pans corresponding to the six pistons from which the molten wax is discharged.

After the pans are filled with the wax, the trays carry them through cooling compartments, where the solid wax cakes are formed. Cooling is done by a stream of cold air supplied perpendicularly to the direction of tray travel. Cold air is obtained by passing the air over five dry coil carrier evaporators connected to a 150-ton Ingersoll-Rand ammonia compressor.

The cooling chamber is completely enclosed and insulated to insure maximum operating economy by recirculating air within the system. For maximum output the refrigerating coils are run at full capacity and the blowers are operated at constant speed. Air temperature is maintained at 20°-30° F. The rate of cooling the wax cakes is controlled automatically by varying the speed of the conveyor; it depends upon the melting point of the wax to be moulded. The higher the melting point of the wax, the greater the unit output.

Construction of chain conveyors passing through the cooling chamber deserves further description because of their ingenious design. After the conveyor reaches the opposite wall of the cooling chamber, the trays are automatically lifted and transferred to the next higher level of the same conveyor to move in the opposite direction. This is done without disturbing even to the slightest extent the partially solidified wax in the moulding pans which would result otherwise in wrinkles on its surface. The doubling of the conveyor may be repeated as many times as desired, contributing to the compactness of the design by substituting height for

* This article is based on a paper by the same authors presented before the regional technical meeting of the Western Petroleum Refiners Assn., at Wichita, Kans., July 20, 1951, under the title, "Continuous Moulding of Paraffin Wax."



Pans filled with liquid wax enter the cooling chamber

length of the cooling section. In the Magnolia installation the trays make 14 passes through the cooling section, traveling a total distance of about 800 ft. in a space 64 ft. long and 10 ft. high. The entire moulding unit is driven by one 10-hp. motor through a variable speed reduction gear. The residence time of the wax in the cooling section may be adjusted anywhere from 60 to 180 min. by varying the speed of the main drive gear.

The surface temperature of the wax cakes leaving the cooling chamber is controlled between 60° and 80° F., depending on the melting point of the wax. The lower the melting point, the lower the temperature at which the wax cakes are discharged.

The wax cakes are also removed from the moulding pans automatically. The pans which are attached to the trays are tilted until they are in the upside down position and the cakes drop from the pans. The chain conveyor makes another turn and the trays and pans assume their former positions. The bottoms and sides of the empty pans are heated slightly by passing the trays over an electric heater before starting the next traveling cycle through the system. The wax cakes dropped from the pans are picked up by a belt conveyor.

The original installation included an automatic weighing device for inspecting the wax cakes. However, this device was soon found to be superfluous because the individual cakes vary less than 0.2% by weight from the average. In the conventional batch moulding process, cakes of similar sizes varied in weight by as much as 5%.

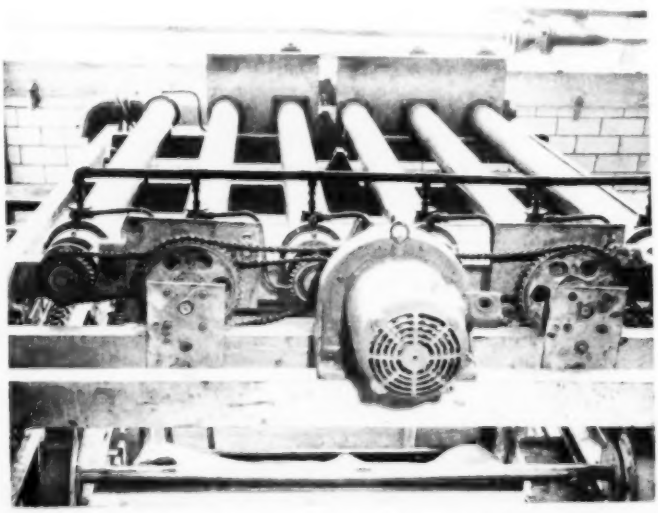
The equipment which has been installed at the Beaumont refinery is capable of moulding from 11,000 to 17,000 lbs. of wax per hour, again depending upon the wax melting point. The wax cakes are uniform in size and have a bright luster appealing to the eye. No wax is slopped except at the very beginning of the operation while the equipment is brought up to equilibrium conditions. This slop wax is returned to a special melting tank for reprocessing.

The labor requirements per unit weight of moulded wax produced was reduced five times as compared to the conventional batch process, with further savings in sight. The larger the volume of the wax moulded, the greater the savings in manpower.

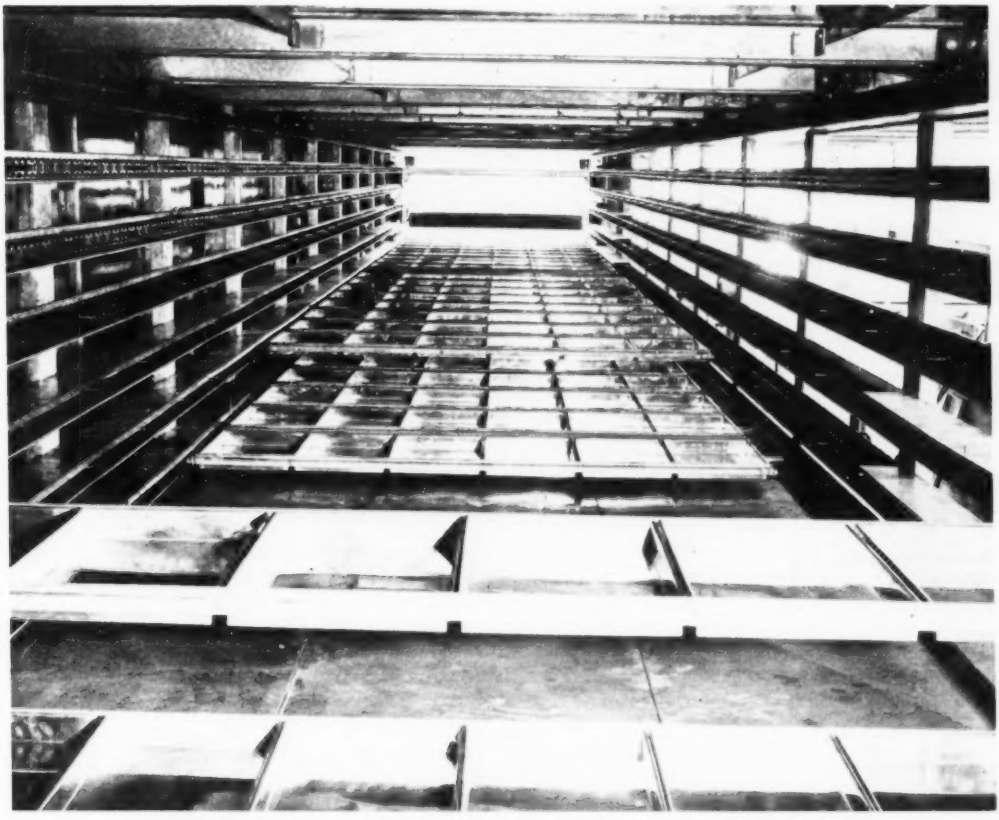
The appearance of the conventional wax moulding rooms, with wax spilled on the floor and equipment, is practically eliminated. The floor space required for accommodating the equipment is not over one-tenth of that normally occupied by the wax moulding presses and may be further reduced, if desired, by increasing the height of the cooling chamber.

The new continuous process is also well adapted for automatic packaging of wax cakes into paper boxes and discharging these boxes directly into the freight cars. This makes the process highly desirable from the sanitary point of view, because handling of wax or wax cakes by hand may be completely avoided from the time the crude oil is obtained by the refinery until the finished product is delivered to the customer.

The development of new techniques both in wax processing methods and now offered in wax moulding has been required because of the rapid growth of the petroleum wax industry. For many years paraffin wax



Tempering exchangers for equalizing the temperature of the molten wax



Cooling chamber under construction, showing position of the lower rows of tray and pans

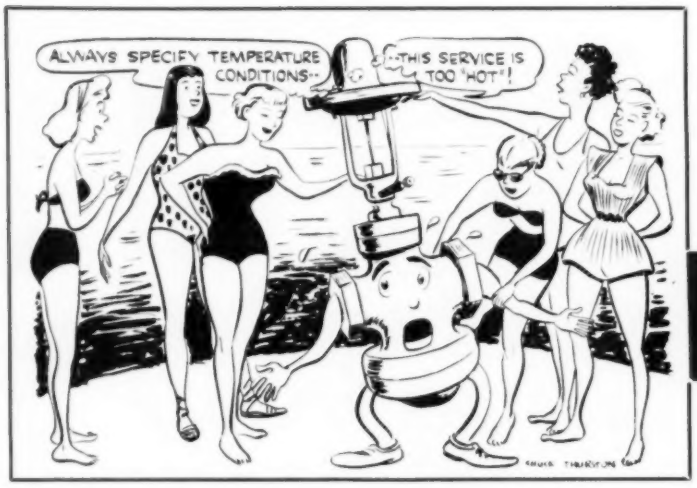
was regarded as a surplus product of little value to refineries and was normally disposed of as a cracking stock. Only a small portion of the mineral waxes necessarily manufactured in the normal refining processes ever found commercial outlets. What little wax was sold was utilized mainly as an adulterant, or as a cheap substitute, for vegetable and animal waxes. Today, however, the advancing knowledge of the nature of mineral waxes has resulted in greatly increased popularity for their products. The petroleum waxes have also won new outlets on their own merits, and the wax industry as a whole has acquired an important position in industrial and home life.

The rapid growth of the industry is seen from the fact that the total quantity of petroleum waxes which will be produced in the U.S. in 1951 will pass 1,000,000,000 lbs. This represents an increase of 30 to 40% over the last decade. Considerably more than one-half of this figure will be represented by paraffin waxes of various melting points. Close to three-fourths of these waxes will be consumed for processing paper, while the rest will be utilized in candle and electrical insulation manufacture, in the textile, leather, cosmetic and lumber industries and in the formulation of polishes. These varied uses also explain the necessity of supplying a widening market with more than one grade of wax.

While wax processing methods have steadily improved, techniques for moulding the wax into cakes or slabs have remained practically unchanged from the batch moulding method first used by the industry. Conventional equipment is still represented by a modified plate and frame press with moulds and cooling plates substituted for rings and filter plates.

In this batch method the sides of the moulds and the plates project about 3 in. above the top when the press is assembled. The upper portion of the system resembles a long pan with openings at the top of each mould. The molten wax is pumped into a tank from which it gravitates into the pan and through the openings into the moulds. The wax is always at atmospheric pressure and the pressure from the press is applied only for holding the plates in place.

After the moulds are filled, water is circulated through the cooling plates. A layer of liquid wax is maintained in the pan while the wax solidifies. This is necessary because of the uneven shrinkage of the wax cakes, which undergo a 15 to 17% contraction from a liquid just above the melting point to a solid at room temperature. During the solidification process, heat is sometimes applied to keep the wax in pan liquid, thus insuring its easy flow into the moulds to form relatively uniform cakes. The cooling period lasts from 2 to 3 hrs. depending upon the melting point of the wax and the temperature of the cooling water. After the cakes are formed, the surplus wax remaining in the pan is scraped off, the press is opened, and the cakes removed manually.



No. 2 in a series on How to Order Equipment

How to Get What You Need When You Order a Valve

By D. P. THORNTON, Jr., Southwestern Editor

THE first article of this series described many of the peculiarities encountered in the relationship between oil companies and suppliers of the equipment they use, notably the lack of agreement on data to be disclosed in placing orders or bid invitations. The information necessary to enable the manufacturer, supply company or sales representative to intelligently fit the proper manually-operated valve for the application at hand was discussed in detail. It also brought out that manufacturers' catalogs in general are seldom intended as "promotional pieces" and should be utilized in selecting types of equipment and writing specifications.

Most of this needed information carries over into the closely-associated subject of non-manually-operated valves. These include not only power-operated and instrument-controlled valves, but also check and float-operated valves as well as liquid traps. Although they may not normally be considered so, in general traps are a form of float-operated valves. Some designs even may be technically termed "control instruments" because they may be used to maintain liquid levels in lieu of the conventional type of liquid level controller, which operates a valve directly or through a motor operator of some kind.

Again it should be borne in mind by the buyer, lest the listings of data required seem lengthy and formidably detailed, that non-manually operated valves are not only valves but valves in which the handwheel or wrench is replaced with an operating device of some kind. Due consideration for the peculiarities and limitations imposed by the actuating mechanism, therefore, is equally as important as accurately and completely specifying the conditions under which the valve portion must function satisfactorily. (*Continued top of next page*)

Data Needed on Any Valve Order

For the reader's convenience, information to be supplied when ordering manually-operated valves is repeated below in brief form. This data is necessary in adequately specifying the service application of the valve portion of non-manual valves. These apply generally to any kind of valve. The explanatory portion of the original listing—why this information is needed—is not repeated and for details the reader is referred to PETROLEUM PROCESSING for July, 1951, p. 722

1. Give "figure number" obtained from manufacturer's catalog.
2. Nominal (pipe) size.
3. Maximum temperature (minimum also if sub-zero).
4. Maximum pressure.
5. Specify if throttling or open/closed service.
6. Specify special trim and body material only when required.
7. Nature of fluid—water, oil, gas or other (specify).
8. If service is throttling and fluid other than water, state specific gravity at specified temperature and pressure, or molecular weight.
9. Presence of corrosives or abrasives.
10. Type of connection—screwed, hub flanged (specify type and rating) or welding neck (specify bore). (Advise any special drilling for flanges).
11. Specify requirements for special name-plate markings.

These valve types are actuated by a multiplicity of mechanisms, including cylinders, electric and fluid-driven motors, diaphragms, bellows, floats and solenoids. Consequently, selection of some of the types offered will not alone be dictated by the physical characteristics of the fluid handled and its chemical nature, but by the demands of the process involved; sometimes environment plays an important part in selection.

It is not intended to go into the intricacies of actual selection of non-manually controlled valves or the advantages and disadvantages of various types of plugs and seats or types of operation. It is debatable, in fact, whether or not mention of power-operated valves shouldn't have been included in the preceding article of this series. However, they are included here primarily because the signal need not be initiated by the process operator.

Data required when ordering power-operated valves

The major difference between a power-operated and a manually-operated valve is that some mechanical force has been substituted for the handwheel, chain operator, or wrench. This in general may be a piston, electric or fluid-operated motor. Use of a power operator may be desirable because of inaccessibility or remoteness of valve location, for safety, or because hand operation is too difficult or slow in view of the size of the valve. It may be necessary, because of conditions, to specify whether or not the valve is to have an integral by-pass and if this, too, is to be power-operated. Supply the following information when ordering:

CYLINDER-OPERATED VALVES

1. Catalog or "figure number" of valve, size, service and description. (This involves the same information as noted in the previous article for manually-operated valves, and summarized briefly in the accompanying box. Certain data called for also are repeated below because of special significance.)
2. Maximum working pressure and maximum differential pressure for valve to handle.
3. Information on special conditions. (In addition to trim, corrosive conditions, etc., specify also if valve must close against full-flow, open against full pressure, or if coking is present. Maximum fluid velocity through valve is desirable, if known.)
4. With or without integral by-pass wanted, specify position with respect to valve.)
5. Fluid to operate cylinder (air, gas, water, oil, etc.)
6. Pressure available for operating fluid. Some manufacturers have both maximum and minimum pressure limitations.)
7. Maximum temperature, working and ambient, for cylinder.
8. Specify desired speed of operation and frequency.
9. Position of cylinder with respect to valve and is pipe run horizontal or vertical. (Cylinder parallel or at right angle to valve, above or below valve when installed.)
10. Specify if valve position indicator is desired: integral or remote type. (Standard practice varies.)
11. Specify if control valves for operator to be supplied and how actuated. (Usually furnished at extra cost. Consider pipe size with respect to pressure drop if remotely located from valve.)
12. Specify if operating fluid to discharge otherwise than to atmosphere.
13. Specify if provision for auxiliary manual operation desired.

ELECTRIC MOTOR-OPERATED VALVES

1. Items 1 through 4, and items 8, 10, and 13 for cylinder-operated valves.
2. Power characteristics. (AC or DC, voltage, phase, cycles per second.)
3. Type of enclosure. (General purpose, weather proof, explosion proof, etc. NEMA classification preferred; note manufacturer's "standard.")
4. State kind of stations desired and number per valve. (Open-close, open-stop-close, lock or non-lock, etc. and type of enclosure.)
5. Note that relay-contactor panel and transformers where required may or may not be furnished by valve supplier, as stated in catalog.

FLUID MOTOR-OPERATED VALVES

1. Items 1 through 4 and items 8, 10, 11, and 13 for cylinder-operated valves.
2. Operating medium. (Air, oil or water.)
3. Available operating pressure.
4. If a conversion unit for a manually-operated valve, state all valve nameplate and body markings, manufacturer, catalog number and approximate date purchased.

Data required when ordering instrument-operated valves

There are a multiplicity of types of the so-called instrument-operated valves, as well as valves actuated by bellows and other arrangements sensitive to temperature and pressure. The selection of many of these types will be dictated in part actuating devices, such as regulators, and are treated elsewhere in this article. This is principally because the actuating mechanism is an integral part of the assembly which cannot be readily made-up from components in the field.

Discussion here is confined to external pilot-, diaphragm- and bellows-operated valves. The merits or demerits of the various shapes of plugs and single vs. double-ported designs are not considered. Likewise, the subject of diaphragm or bellows loading has been avoided. It should be noted, however, that many manufacturers make only the valves, supplying operating motors at purchaser's option. When ordering motors only, full particulars describing the valve it is to fit should be supplied, including date of purchase and all figures on valve body and nameplate. Supply the following information when ordering:

1. Catalog figure, series or type number and information previously listed for ordering manually-operated valves. (With reference to type number, some manufacturers have optional specifications for body material not covered by catalog figure or series number. Some catalogs leave specification of trim to customer. Under nature of fluid, some catalogs ask that specific gravity and viscosity be included.)
2. Specify auxiliary motor operator equipment. (Handwheel, stem "jack", etc.)
3. When ordering replacement valves, first compare current catalog body dimensions with those of old valve. Some designs recently have been altered considerably or now are obsolete.
4. Type of inner valve if optional. (Advise throttling, on off, quick-acting service.)
5. Stem movement or lift. (Important if motor operator is supplied separately.)
6. Type of bonnet. (Lubricated or radiating fin, extension type, bellows seal.)
7. Maximum rate at which valve must open or close. (If important to process involved.)
8. Pressure range of control fluid to valve operator

(e.g., 3-15 psi., line pressure, etc. Specify nature of fluid to be in contact with diaphragm so proper material will be furnished.)

9. Differential pressure maximum across valve. (Up-and-downstream pressure ranges.)

10. Motor operator—specify:
   a. Direct- or reverse-acting.
   b. Whether or not spring-loaded.
   c. If positioner required. (Usually on temperature control applications.)
   d. Valve action desired on failure of operating fluid. (Fail open, closed, etc.; generally an optional safety feature.)

Paint and dirt are common contributors to stem-sticking difficulties and therefore some manufacturers supply removable covers for this portion of the motor operator and bonnet assembly as standard practice. Some others can supply them as optional features or as special orders. When this feature is desired, reference should be made to the catalog standard.

ORDERING PARTS

1. Always give valve serial number when ordering parts; preferably supply all nameplate data as these positively identify valve. Body markings generally do not completely describe valve. If nameplate is lost, give date of purchase order, catalog figure number, etc., and include "special" instructions, if any.

2. Give part number from catalog or parts list, stating date or number of *list*.

3. Describe part accurately, preferably using catalog nomenclature.

4. When ordering new trim or plugs, especially if *different* from that originally supplied, specify valve size and plug type if known.

5. When ordering *new* valve body note that current designs may differ considerably from earlier valves, due to recent adoption of manufacturers' standards for face-to-face dimensions. Specify flange type and special drilling.

6. If operator was supplied separately from valve, operator serial number will *not* identify valve, and vice-versa. Nameplate data for *both* should be given.

Data required when ordering pressure and temperature regulators

Pressure and temperature regulators basically are the same device except for the method of actuation. They consist of a means for sensing the change of pressure or temperature and a valve which operates to correct the condition. In this sense they may technically be classified as a special case of "control instruments" but are included here because they usually are considered as valves.

Regulating valves actuated by an external pilot or some type of control instrument are not treated in this section because the valve could be diaphragm-operated, or some other type already discussed. Nothing in its construction helps sense the condition to be regulated. The only requirements governing its selection are demands of the actuator, fluid to be controlled, and ranges of pressure, temperature, and flow rate involved. The external pilot or other sensing means, since it is external, though perhaps mounted on the valve, will consequently be treated later under control instruments.

PRESSURE REGULATORS

1. Catalog number and type, and information previously listed for ordering manually-operated valves.

2. Nature of fluid handled. (Give specific gravity; also viscosity for liquids.)

3. Service application. (E.g., fuel supply to burner, steam to heater, air to control instruments, etc.)

4. Size of inlet and outlet connection, when optional (pipe size). (Specify screwed or flanged when optional and if companion flanges desired.)

5. Type of bonnet—plain, lubricated, or packless. (In most catalogs this is included when specifying type or catalog number.)

6. Maximum capacity. (GPM, lbs. hr., etc.)

7. Maximum and operating (inlet) pressures.

8. Reduced (outlet) pressure setting or range.

9. Operating temperature.

10. Control action. (Increase in pressure to open or close valve.)

11. Trim and body material, when optional.

TEMPERATURE REGULATORS

1. Catalog number and type, and information previously listed for ordering manually-operated valves.

2. Nature of fluid:
   a. Handled by valve.
   b. In which temperature sensing medium immersed.

3. Valve size. (type connection when optional.)

4. Maximum temperature and pressure of flowing fluid.

5. Temperature setting or range.

6. Maximum capacity. (GPM, lbs. hr., etc.)

7. Valve trim and body material, when optional.

8. For bulb-types specify:
   a. Distance between regulator and point of temperature measurement.
   b. When multiple choice, desired length of bulb, including threads.
   c. Finned or plain bulb.
   d. Bulb connection (screwed or flanged.)
   e. State if armour required. (Desired material, if known.)
   f. If subject to corrosion specify bulb material if known. (Even negative information helpful.)

Data required when ordering traps and level controllers

One of the most important points when ordering a trap is to be sure it has sufficient capacity to handle the maximum volume of liquid anticipated and at the same time be efficient in venting off the smallest amount of desirable vapor when discharging. For general drainage most any trap will give satisfactory service, but for specific cases there are many types particularly recommended for these services. Consequently the more information supplied with the order the better for the buyer.

Several manufacturers give excellent technical discussions in their trap catalogs on determining capacity and recommendations for selecting the proper type for specific applications. If the selection problem is complex, or in case of doubt, most manufacturers will gladly make recommendations on receipt of proposed application details.

Except in cases where an external control-type valve is actuated, a liquid level controller may be considered a special type of a trap. Indeed some conventional traps may be installed as level controllers. Some trap manufacturers, however, prefer to have specific details on the proposed installation before recommending their traps as level controllers. Because of the similarity, level controllers directly actuating a valve built integral with the controller and not acting through a pressure pilot or similar device, are treated here. Level controllers actuating a pressure pilot or control instrument will be discussed later in this series. Supply the following information when ordering:

1. Catalog number and type. (open or inverted bucket, thermal or float.) (Some manufacturers also use code words. Specify body material and trim if optional or requirement is not catalog standard.)

2. Type of inlet and outlet connections (screwed or flanged), also size of connection when optional. (Catalog number specifies size for all or only certain types in some catalogs.)

3. Service and nature of liquid. (steam, oil, ammonia, others.) (Give specific gravity if other than steam for open bucket or float-type traps and for liquid level controllers of either float or displacement type. Advise if corrosive, state capacity—gpm., lbs./hr., of liquid.)

4. Maximum inlet pressure.

5. Differential pressure. (Inlet minus outlet pressure; give maximum and minimum if operating pressures are widely variable. Consider start-up conditions also, when differential may be much greater than during "normal" operation.)

6. Flow (pulsating or steady).

7. Specify if uncondensible gases present in large quantities. (Some trap types are not recommended for such conditions.)

8. Control action, level controllers. (Valve to open or close when level increases.)

9. Specify with or without internal strainer when optional.

10. Specify if companion flanges desired.

ORDERING PARTS

1. State catalog number of trap or level controller and parts number(s). (Also show number or date of catalog or parts list used.)

2. Give all information found on nameplate, if available.

3. Describe part.

4. Specify pressure rating and operating pressure; capacity if known.

Data required when ordering relief valves

Pressure and vacuum relief valves may be considered as special purpose pressure regulators and some designs of pressure reducing valves may be used either for pressure reduction or pressure relief. Supply the following information when ordering:

1. Catalog figure, type or series number.

2. Size of inlet and outlet, screwed or flanged. (If flanged specify drilled or undrilled and special drilling requirements.)

3. Service and nature of fluid handled. (Advise also molecular weight or specific gravity. Some manufacturers supply valves for steam if nature of fluid unspecified.)

4. Pressure (or vacuum) to open. (Specify adjustment range or "set point." Note overpressure limitation stated in catalog when passing maximum quantity of fluid.)

5. Maximum pressure and temperature.

6. Trim. (Specify if other than "standard.")

7. Presence of corrosives and abrasives.

8. Volume of fluid to be handled—cfm., gpm., etc. (Important especially if size unspecified. Also will minimize chance of error in specifying size and permit recommendations to give equipment concerned the maximum protection. Give pressure and temperature under relief conditions.)

9. Specify lifting gear if optional. (See catalog.)

Data required when ordering check valves

There are several different types of check valves to choose from, some of which have been developed for special applications. These include uses where sensitivity to flow reversal or opening on minimum pressure are desired, when extremely pulsating flows are encountered and where the feature of dual function as both stop and check is desired. Consequently, it is very desirable for the manufacturer to know the service conditions in order to furnish the most serviceable valve type, as well as in determining trim and disc composition. Supply the following information when ordering:

1. Catalog or "figure number" of valve, size service and description. (This involves the same information as for manually-operated valves as to maximum and working temperatures and pressures, nature of fluid handled, trim and presence of corrosives or abrasives.)

2. Type of flow (steady or pulsating). (Ordinary swing checks generally are not used for pulsating flow as they are conducive to "hammer" or shock conditions in piping.)

3. Is flow extremely pulsating? (Lift-type checks with cushioning chamber or dashpot recommended for such cases.)

4. Specify if by-pass required, location if important and different from catalog standard.

5. If outside lever and weight specified is valve to be sensitive to flow reversal or to open under minimum of pressure.

6. Specify type of connection if optional. (Screwed, flanged, drilled or undrilled, and dimensions if not "standard.")

7. Specify type of lifting gear if desired or optional.

Next Article Will Cover Pumps

Information required in ordering pumps will be discussed in the next article of this series.

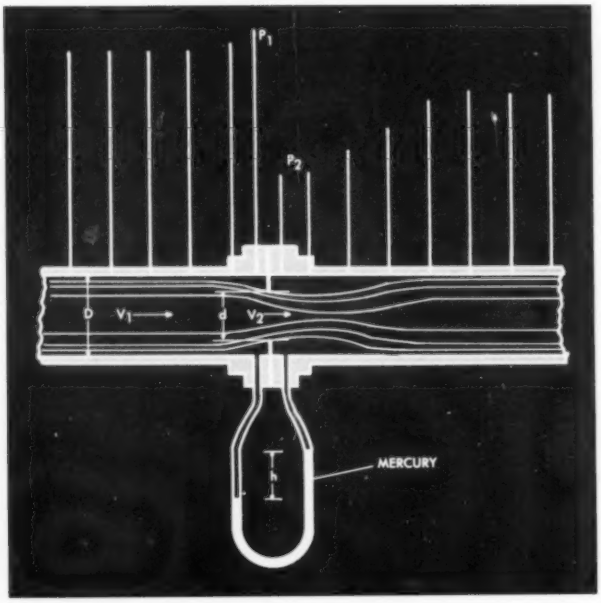


Fig. 8—Basis of flow measurement is the effect of an orifice plate on pressure and velocity of a fluid in a pipe

REFINERY INSTRUMENTS

What Makes Them Tick?

Part 2—Flow Measurement

By **CORNELIUS E. SHANNAHAN**, *Instrument Engineer*,
M. W. Kellogg Co., New York

WHEN a fluid flows in a straight pipe, the velocity is the same at all points along the length of the pipe. When an orifice plate is placed in the pipe, as illustrated in Fig. 8, a change in flow conditions is effected. This change is utilized to measure flow.

What has happened is that the constriction in the line makes it necessary for the fluid to flow faster through the orifice opening and due to the increased velocity, a pressure drop is momentarily produced. It will be noted in Fig. 8 that the contraction continues downstream from the orifice plate until it reaches a minimum cross section, which is known as the vena contracta. The location of the vena contracta remains the same for any rate of flow. The greatest usable pressure difference across the orifice is obtained when connection P_1 is one pipe diameter upstream and P_2 is at the vena contracta.

Referring now to Fig. 9, which shows a simple vessel filled with liquid to a depth H above an outlet, a basic law of physics as developed by Torricelli follows:

$$V_2 = \sqrt{2gH}$$

where: V_2 = velocity of issuing stream.
H = height of liquid, in ft.
g = gravity.

This is derived merely by equating potential and kinetic energy, $mgH = \frac{1}{2}mV^2$, in which m = mass. Now by analogy with Fig. 8, the comparison can be made that the height of liquid in Fig. 9 actually represents the differential pressure across the jet and therefore the same formula may be applied to the orifice. The volume of liquid discharged per unit of time can be calculated by multiplying the area, A, of the orifice by the orifice velocity:

$$Q = AV_2 = A\sqrt{2gH}$$

and $H = h/12G_f$

where: Q = volume rate of flow.
D = inside diameter of pipe.
d = diameter of orifice bore.
h = differential across orifice in inches of water.
G_f = specific gravity of fluid at flowing conditions.
G_s = specific gravity of fluid at standard conditions.

Simplifying all constants to K, converting A to terms of d^2, H to inches of water differential across the orifice ($H = h/12G_f$), and multiplying by G_f/G_s in order that the meter read at standard conditions:

$$Q = Kd^2 \frac{G_f}{G_s}\sqrt{\frac{h}{G_f}}$$

In connection with the use of this formula, the d/D ratio is limited to a maximum of 0.75. At higher d/D ratios, errors are introduced due to the

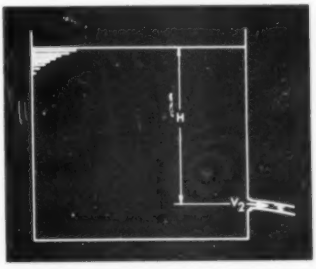


Fig. 9—Demonstration of Torricelli's Law

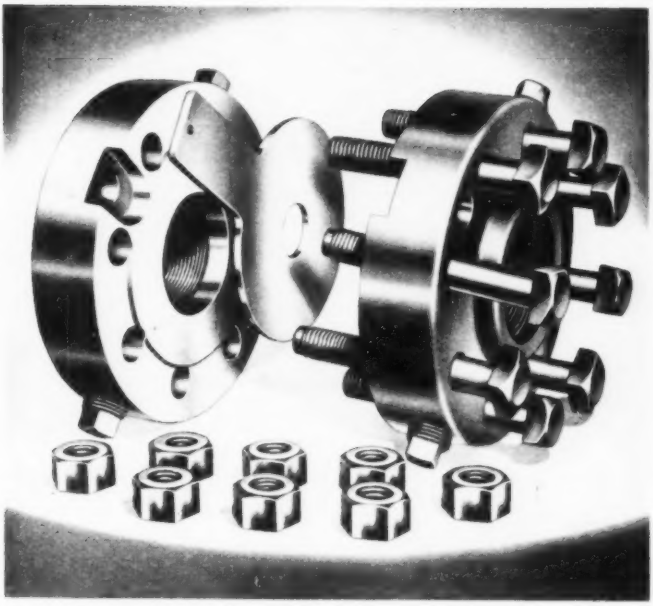


Fig. 10—Typical orifice plate, concentric type, with flange union

Fig. 11—Typical flow nozzle

irregularities of the pipe which make it impractical to predict consistent flow constants. When faced with a high d/D ratio, the instrument engineer has two alternatives, and they are either to swage the line, or to increase differential h.

Another, and perhaps more complete, approach to the problem of interpreting differential head as a measure of flow is to proceed in accordance with the law of conservation of energy. Neglecting friction, the work done on a mass of liquid to bring it to the condition of elevation, velocity, and pressure at points P_1 and P_2 must be equal. Since this illustrates a horizontal installation, the difference in elevation at P_1 and P_2 is zero. The balance then resolves itself into one of pressure head, P, and velocity head, $V^2/2g$, at the two points being equal.

$$P_1 + V_1^2/2g = P_2 + V_2^2/2g$$

where: $V_1 = V_2(d/D)^2$

$H = P_1 - P_2$

Therefore:

$$P_1 - P_2 = (V_2^2/2g) - (V_1^2/2g)$$

$$= \frac{V_2^2 - V_2^2(d/D)^4}{2g}$$

$$= (V_2^2/2g)(1 - d^4/D^4)$$

Transposing, substituting H for $P_1 - P_2$, and solving for V_2:

$$V_2 = (\sqrt{2gH}) / (\sqrt{1 - d^4/D^4})$$

The difference between this formula and the original derivation is in the denominator, $\sqrt{1-d^4/D^4}$. This expression is referred to as the velocity of approach factor and must be allowed for in arriving at the proper flowing quantities. As noted, this variable is a function of the d/D ratio, and at this time it may be well to mention another variable which changes with the d/D ratio: e.g., coefficient of discharge of the orifice. The coefficient of discharge corrects for the actual velocity being less than the theoretical velocity, V_2. The instrument manufacturer usually plots the product of these factors as well as others for various d/D ratios to arrive at an overall factor E to correct for errors in basic assumptions.

Therefore:

$$Q = KEd^2(G_f/G_g)\sqrt{h/G_f}$$

There are other factors which enter into the calculation of the orifice bore, d, such as expansion of orifice plate due to temperature, the area at the plane of P_2 being different than that at the orifice (incorporated in the E factor), viscosity effects if appreciable, etc. However, rather than digress from the introductory nature of this article, the reader is referred to the bibliography for further study.

In the measurement of gas flow, the same theory applies. $V_2 = \sqrt{2gH/v}$. Converting the height of gas, in feet, to inches of water follows:

$$H_f = (h/12)(d_w/d_g)$$

where: H_f = height of column of gas in feet.

d_w = density of water @ 60° F., 62.4 lbs. cu. ft.

d_g = density of gas at flowing conditions, lbs. cu. ft.

Substituting for H_f:

$$V_2 = \sqrt{2g(h/12)(d_w/d_g)}$$

To determine the gas quantity, Q_v discharged per unit time, the velocity is again multiplied by the orifice area, A. However, it must be remembered that if the meter is to record flow at some standard conditions, which is usually the case, the density of the gas must be corrected for. Or another way of looking at the problem is to consider a quantity of gas, V_2 units long with cross-sectional area A. The volume of this quantity will be a function of its absolute pressure and temperature. It follows, therefore, that in order to design a meter to record for standard conditions when the following gas is at a condition other than standard, the ratio, P_fT_s/P_sT_f must be included.

Therefore:

$$Q_v = (P_fT_s/P_sT_f)V_2A$$

substituting for V_2:

$$Q_v = (P_fT_s/P_sT_f)\sqrt{2g(hd_w/12d_g)}\,A$$

and d_g may be expressed:

$$d_g = d_aG_g(P_f/14.7)(492/T_f)$$

where: P_s = standard absolute pressure, psia.

P_f = flowing absolute pressure, psia.

T_s = standard absolute temperature, °F.

T_f = flowing absolute temperature, °F.

d_a = density of air @ 14.7 psia. and 32 °F., 0.08073 lbs./cu. ft.

G_g = specific gravity of gas relative to air, (Mol. wt. gas)/28.8.

Substituting for d_g in the previous formula, converting A to terms of d^2, substituting values for base conditions T_s and P_s, including an E fac-

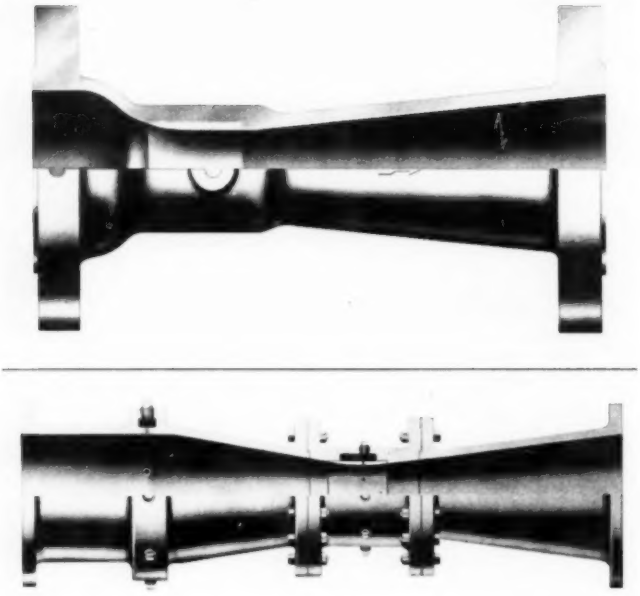


Fig. 12—Typical Venturi tube: (above) modified flow nozzle type; (below) standard short cone type

Fig. 13—Typical pitot tube, adjustable type

tor for the same reasons previously discussed, and simplifying all constants to K_2:

$$Q_s = K_2 E d^2 \sqrt{(hP_f T_f G_s)}$$

It follows, therefore, that the formula for gas flow contains more variables than that for liquid. The most critical variable in the above formula is usually P_f, especially in lines where the pressure is uncontrolled. If this condition exists and accurate measurement is required, it is practically mandatory to measure gas pressure. In most refinery applications, the magnitude of change of either the gravity or absolute temperature is negligible.

Before proceeding to the more practical aspects, it might be well to mention that whereas differential pressure is spoken of in inches of water, the actual differential is usually measured in the meter body with mercury. For example, a 100-in. meter differential represents a differential level in a mercury U-tube of (1/13.55)100, or 7.38 inches.

Besides the orifice, the flow meter may use a number of other primary measuring devices, such as flow nozzle, venturi tube, and pitot tube. However, because of its low initial cost, ease and economy of installation, flexibility and reliability, the orifice plate is the most frequently used.

Aside from cost, the three principal factors for selecting a primary device are:

1—Consistency of operation.
2—Existence of calibration data.
3—Pressure drop.

First; the orifice plate as illustrated in Fig. 10, the concentric type, is the most widely used. The plate is a thin flat disc, usually about $\frac{1}{8}$ in. thick, fitted between flanges and cut with a concentric hole to a specific calculated diameter. The most commonly used type of installation incorporates flange taps which locate the pressure points 1 in. up and downstream of the orifice plate. This eliminates the possible installation error prevalent with vena contracta tap where the location of the downstream tap varies with change in orifice size.

Types of Tap Locations

Other types of tap locations are: radius taps (1 pipe diameter upstream, $\frac{1}{2}$ pipe diameter downstream), and pipe taps ($2\frac{1}{2}$ pipe diameters upstream, 8 pipe diameters downstream). It should be pointed out that, although the flow capacity for the same size orifice is greater with pipe taps than with the others, the d/D ratio should be reduced such that it will pass no more than allowable with any of the other taps. The reason for this is that the pipe tap installation is much more susceptible to error than others.

Eccentric and segmental orifice plates are also available in addition to the concentric type. However, they lack consistent calibration data for flow constants. The eccentric and segmental types do have application where the flow measurement of slurries is required, because they have less tendency to dam up solids.

A flow nozzle is shown in Fig. 11. It has no dead spots and will pass more fluid than the orifice plate. That is, for the same throat size, the flow nozzle gives a lower differential than an orifice plate. Although it rarely occurs, the d/D ratio of an orifice plate will sometimes exceed 0.75 after optimum selection of differential range and/or swaging the pipe size. The disadvantage of d/D ratios greater than 0.75 has already been discussed. Because the flow nozzle gives a lower differential than an orifice plate for the same throat size, it is possible to use a smaller throat, thereby eliminating these inaccuracies.

A common misunderstanding is that pressure recovery of a flow nozzle is better than that of an orifice plate. It must be remembered that in order to obtain the same differential for a given rate of flow, a smaller d/D is required for a flow nozzle that an orifice plate. As a result, pressure recovery of a flow nozzle is actually about the same as that of an orifice plate. Because of the streamline approach of the flow nozzle, sediment carried by the fluid is less likely to deposit on the upstream side of a nozzle. The disadvantage of the nozzle is its prohibitive price and difficult installation.

The venturi tube is shown in Fig. 12. Because of its streamline construction, it can be used for slurries, heavy pulpy substances, etc., without becoming dammed or gummed up.

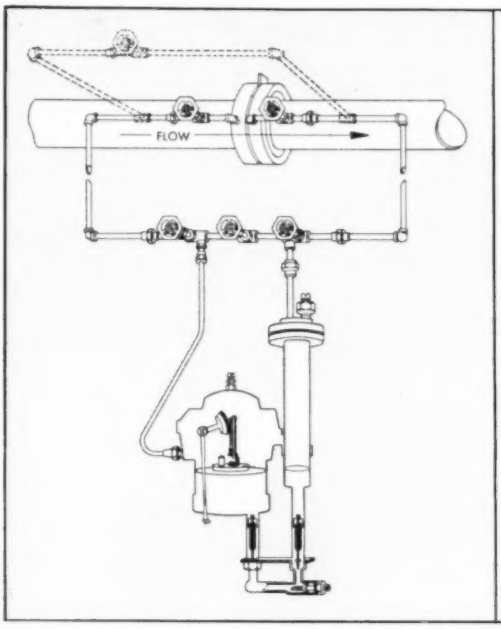


Fig. 14A—Flow recorder, mercury manometer type, overall arrangement

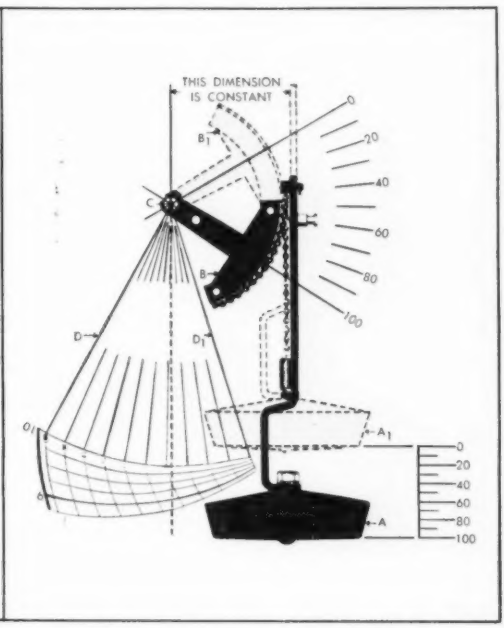


Fig. 14B—Float and segmental lever for transmitting flow measurement to recorder

Pressure recovery for this device runs somewhere in the order of magnitude of 87%. At low pressures where pressure drop is critical, this is an important advantage. Also, where line sizes exceed 8 in. and high pressure recovery is a must, the savings realized in power may cancel the higher initial cost of the venturi tube in a short time.

The pitot tube, shown in Fig. 13, has very limited application. One difficulty is that it measures rate of flow at one point only. Before setting, and under as nearly normal operating conditions as possible, it is necessary to traverse the line with the pitot to arrive at an average velocity of the flowing material. When the pitot position has been established it is recognized that for any other flow rate an error is introduced due to the change in velocity pattern in the pipe. The degree of error depends on the installation and, of course, it is possible to traverse the line to get an average velocity for every condition. The pitot is also very susceptible to dirt and foreign matter. For certain applications it is satisfactory, and on large lines having high velocities, it is much less expensive to install. It also enjoys the advantage of requiring small pressure drop and being very easy to install and remove.

The next question is "how is this flow measurement translated to the indicator, recorder, or controller?" The differential pressure created across the orifice by the line flow is measured by a mercury-filled manometer. As illustrated in Fig. 14, a steel float rests on the mercury and rises and falls with it according to flow variations, transferring its motion to a segmental lever. The segmental lever shaft in turn imparts its motion, through a pressure-tight bearing to the indicator or pen.

Now that the fundamental operation of a flow meter has been discussed, it might be of interest to investigate an application of the basic formulas to a typical refinery application. Suppose for example a design flow rate of 500 gpm. and that an orifice plate is machined to produce a differential pressure of 100 in. water at that rate.

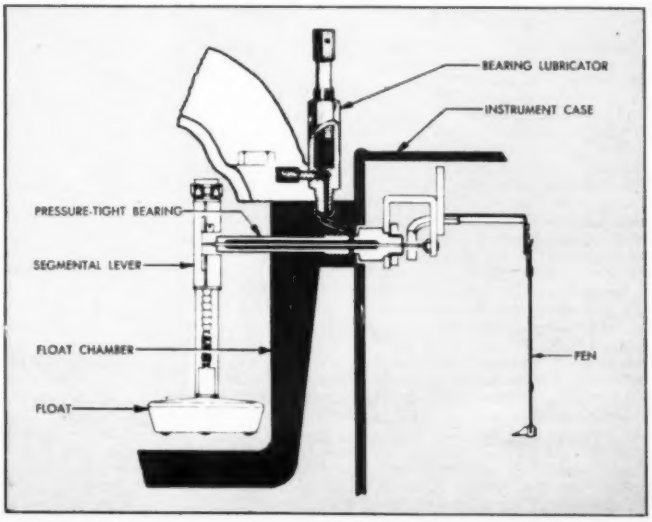


Fig. 14C—Pressure-tight bearing for pen shaft of flow recorder

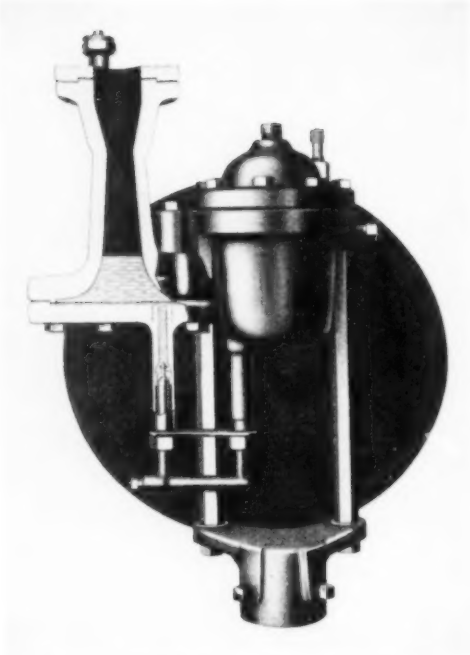


Fig. 15—Differential meter body, which extracts the square root automatically, permitting the use of a uniform linear flow chart

If flow conditions decrease so there is only 50 in. water differential, the flow rate can be calculated as follows (assuming constant specific gravity):

$$Q_1 / Q_2 = \sqrt{h_1 / h_2}$$

$$\text{or: } 500 / Q_2 = \sqrt{100 / 50}$$

$$= 10 / 7.07$$

$$\text{therefore: } Q_2 = 0.707 \times 500$$

$$= 353.5 \text{ gpm.}$$

Since the differential pressure is 50 in. water, or 50% of the design differential, the float has moved 50% of its travel, and has moved the mechanisms accordingly. However, the flow rate at this new condition is actually 70.7% of design rate. Thus, it follows that the charts or indicators must be graduated in square root divisions.

In recording gas flow, it often becomes desirable to record pressure as well as differential pressure for reasons already discussed. Since one is a relationship of square roots, and the other is linear, it would appear at first that two separate instruments would be necessary. Economics, of course, paved the way for a number of solutions and made it possible to record both variables on one instrument.

One solution is to install a segmental chart for recording purposes, alternate segments of which are graduated in square roots and equal divisions. Another solution is to install an indicating scale on the face of the instrument so that gas pressures may be read directly and differential pressures recorded on the square root chart.

By far the most interesting approach is the differential meter body that automatically extracts the square root and permits the use of a uniform linear flow chart (see Fig. 15). Referring back to the previous example, this would mean that for 50 in. water differential across the orifice, the float travel would have to be 70.7% of the full travel for 100 in. water differential range. Or, stating it another way, more mercury is transferred from the high pressure chamber to the low pressure chamber in the low differential regions, so as to give the float in the high pressure chamber a linear relationship to flow.

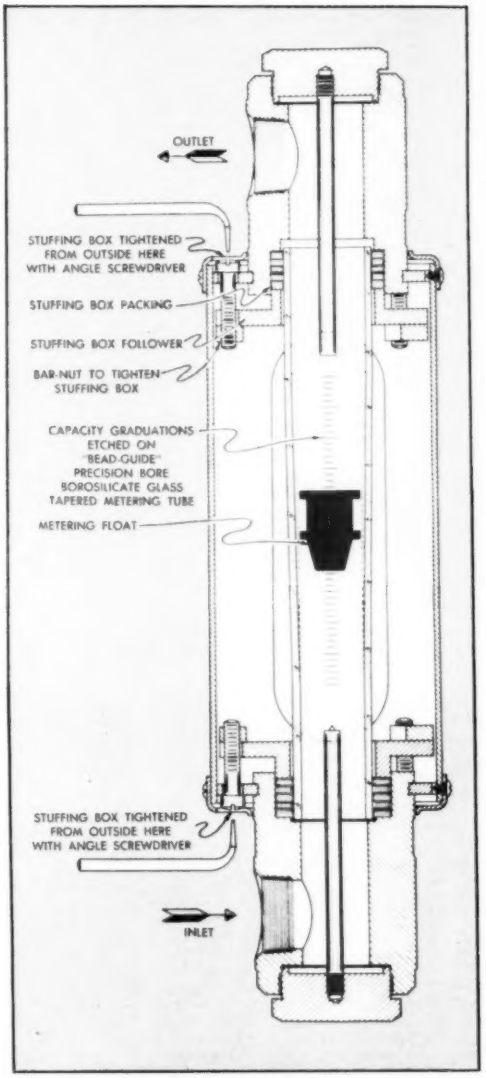

OUTLET
STUFFING BOX TIGHTENED FROM OUTSIDE HERE WITH ANGLE SCREWDRIVER
STUFFING BOX PACKING
STUFFING BOX FOLLOWER
BAR-NUT TO TIGHTEN STUFFING BOX
CAPACITY GRADUATIONS ETCHED ON "BEAD-GUIDE" PRECISION BORE BOROSILICATE GLASS TAPERED METERING TUBE
METERING FLOAT
STUFFING BOX TIGHTENED FROM OUTSIDE HERE WITH ANGLE SCREWDRIVER
INLET

Fig. 16—Variable-area flow meter, or rotameter

Variable-Area Meters

Another satisfactory means of measuring flow is the rotameter, or variable-area flow meter. This type of device is especially useful for applications in small and/or viscous flow. In larger lines, however, the rotameter does not compare favorably with the orifice meter economy-wise. This seems reasonable in view of the fact that with orifice meters only the orifice plate increases with line size, whereas with the rotameters the complete assembly must increase.

Another advantage of the rotameter is its greater rangeability over the fixed area type meter. For example, the orifice meter requires a square root indicator or chart, and is very difficult to read in the lower ranges of flow

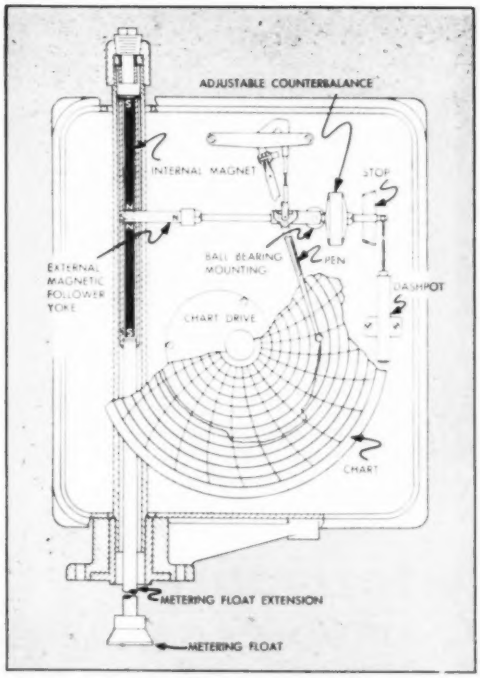


Fig. 17—Induction bridge type transmission for a rotameter

rate. When the maximum to minimum flow ratio exceeds 3, it is usually necessary to consider dual range or dual orifice plates with this type meter. On the other hand, the rotameter measures flow linearly and has a rangeability of between 10 and 20 to 1.

The rotameter differs from the orifice meter in that it has a variable low area and constant pressure drop, while the latter has a fixed flow area and variable pressure drop. The rotameter in its simplest form is illustrated in Fig. 16. It consists of a tapered tube, usually glass, and a metering float which is free to move in the tube. In order to move the float, the buoyant effect of the liquid plus the upward fluid pressure must overcome the weight of the float plus the downward fluid pressure. The pressure drop across the float is created by the increase in velocity of the flowing material through the annular passage, in accordance with the law of conservation of energy.

Effectively then, the pressure differential across the float due to velocity, a function of the annular area, must overcome the weight of the float minus the weight of fluid it displaces, a constant. Therefore, for every flow rate, there is one and only one position of the float for which the annular area so produced will create the necessary pressure differential to buoy the float.

Or in the theoretical form, the rotameter is actually measuring A in the basic formula, $Q = A\sqrt{2gH}$, which establishes the basis for its uniform graduation. It is interesting to note that if the calibration of the tapered tube is to be linear throughout, the tube must be "characterized" so that the annular area, which is a function of the tube diameter squared, increases directly proportional to the metering float rise.

In order to record flow, an extension is added to the metering float to which is attached a magnet (see Fig. 17). An external magnetic yoke follows the motion of the internal magnet. The pen in turn is linked to this yoke and records flow rate. Another type of rotameter uses an induction bridge for transmitting the measurement electrically to a remote receiver, as shown in Fig. 18.

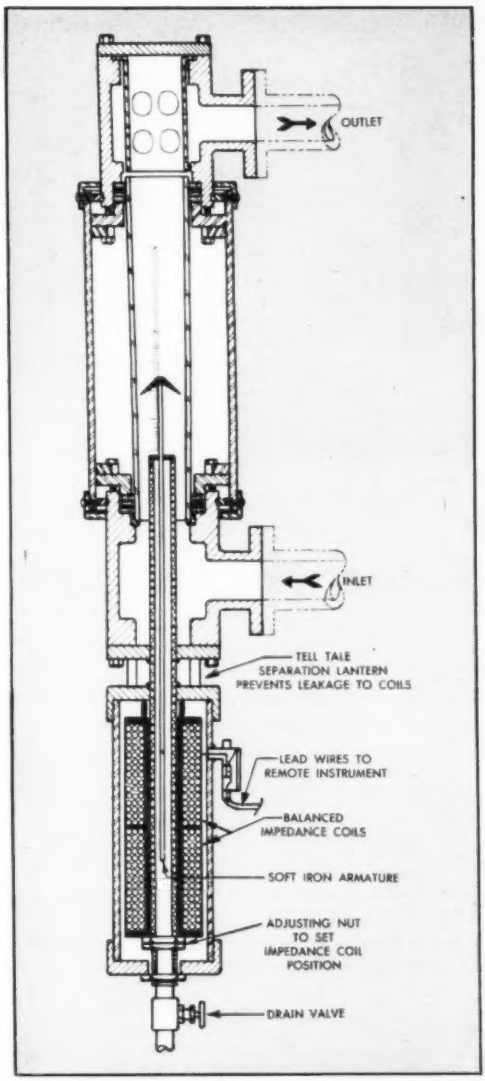


Fig. 18—Recording mechanism for variable-area flow meter, using magnetic transmission

Displacement meters are also used in a refinery, although this type is usually limited to totalizing applications, such as on product streams. There are a number of different designs available on the market. But almost all operate on the principle of piston displacement to drive a register.

References

"Principles and Practices of Flow Meter Engineering," by L. P. Spink.

"Theory of Flowratory," Fischer & Porter Co.

Picture Credits

Illustrations for this article were furnished through the courtesy of The Buffalo Meter Co., Fischer & Porter Co., The Foxboro Co., and Minneapolis-Honeywell Regulator Co., Industrial Div. (Brown Instruments Div.).

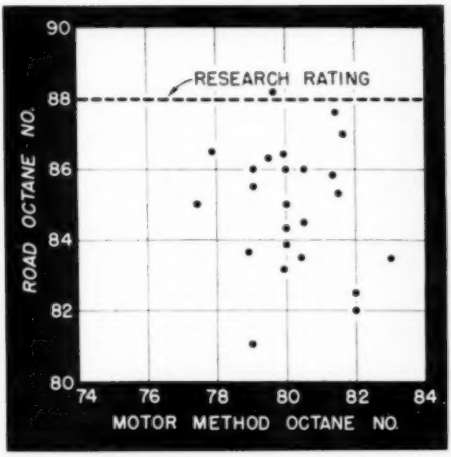


Fig. 1—Road rating vs. Motor Method rating. Fuels of 88 Research Octane; 1949 Car Q2

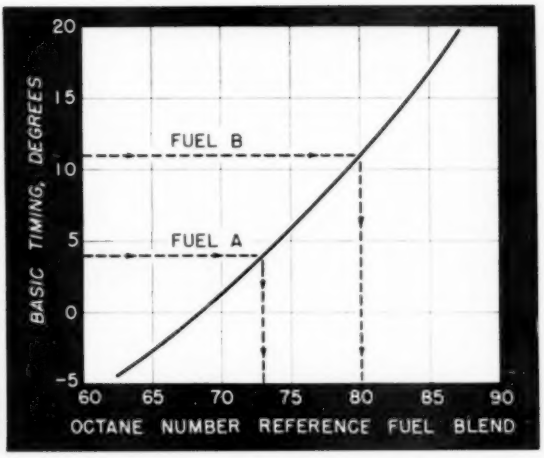


Fig. 2—Modified Uniontown Method, reference fuel octane number vs. basic ignition timing for trace knock

Road Antiknock Performance OF MOTOR GASOLINES

The importance of evaluating antiknock performance of fuels under conditions approximating those experienced on the road is emphasized. The various road knockrating test procedures are listed, together with factors which may influence the road ratings of given fuels. These include make of engine, ignition timing, fuel maldistribution, and variations in temperature, humidity and barometric pressure.

The more recent Borderline Procedure for road antiknock rating (CRC Designation F-8A-943) is described as offering a means for studying the relationship between ignition timing, engine speed and knocking tendency. The relationship of results by this test with those by laboratory antiknock test methods is discussed. Use of the torque-converter type of automatic transmission may or may not change the maximum antiknock requirement, depending on the engine.

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THE octane number of a gasoline is not a definite physical property, but is instead a characteristic which is dependent on the engine and conditions under which it is measured, as well as the hydrocarbon composition of the fuel itself. This is one of the reasons why no formula applicable to all gasolines has been developed by which the road rating of a gasoline may be accurately calculated from its Motor and Research octane numbers. Although laboratory ratings are helpful, the Ethyl Corp.'s experience has indicated that these ratings cannot always be taken as a true indication of the fuel's antiknock performance in vehicles on the road.

This fact is clearly shown in Fig. 1, in which the road-octane-number ratings of a series of gasolines (which all have a Research rating of 88) are plotted against their Motor Method octane numbers. As may be noted, the road ratings of these fuels vary from approximately 81 to 88. Although the Motor Method ratings of the fuels vary as much as 5 octane numbers, this alone does not account for the wide variation in road ratings. This is illustrated by the two fuels which give the highest and lowest road ratings. Both of these fuels have the same Research rating and essentially the same Motor Method rating, yet vary 7 octane numbers in road rating in the same car.

These results indicate that the final proof of a gasoline's ability to operate satisfactorily from the standpoint of antiknock performance should be determined by tests in cars on the road. The only way that a refiner may be certain of providing a gasoline with optimum road antiknock performance, with respect to a given laboratory rating, is to determine the best combinations of his blending stocks through adequate road tests made in a number of representative cars. However, once correlation between road and laboratory ratings has been established for his particular stocks, laboratory ratings may then be used to insure uniformity of product.

Laboratory Knockrating Methods

In any discussion concerning road ratings, some brief description should also be made of the current methods used to determine the laboratory ratings of gasolines. The octane number scale, as is common knowledge, is the yardstick by which antiknock quality is usually measured. This is an arbitrary scale based on the widely different knocking char-

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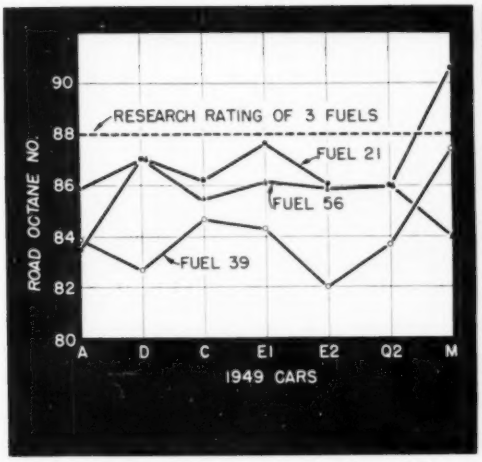

Fig. 3—Effect of car make on road ratings of three fuels of 88 Research octane number

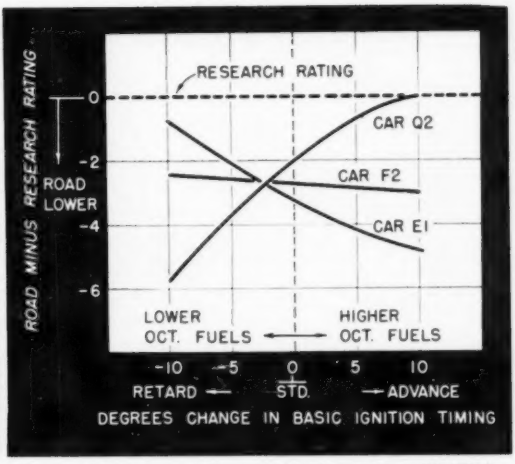

Fig. 4—Road depreciation vs. ignition timing, Modified Uniontown Method

acteristics of two reference hydrocarbons, normal heptane and isooctane. The laboratory octane number of a gasoline is obtained by matching its knocking tendency in a standard single-cylinder CFR engine with that of a specific blend of these two reference hydrocarbons, usually termed primary reference fuels.

At the present time, there are two standard laboratory test methods used to determine the octane numbers of motor gasolines. These are the ASTM Motor Method (ASTM Designation D357-47) and the ASTM Research Method (ASTM Designation D908-47T). Both methods employ the standard single-cylinder laboratory CFR engine, which has a variable compression ratio, and are similar except for operating conditions, shown in Table 1.

The laboratory octane numbers of some typical refinery stocks are shown in Table 2. As may be noted, the Research ratings of the cracked gasolines are considerably higher than their Motor Method ratings. These differences (the Research octane number minus the Motor Method octane number of a gasoline) are accepted as a measure of each gasoline's "sensitivity" or "jump," which is recognized as one of the factors influencing antiknock performance at different engine speeds. The effect of "sensitivity" on the road ratings of gasolines will be discussed later in the section devoted to the research and development of gasolines with satisfactory antiknock performance over the engine speed range.

Road Evaluation of Commercial Gasolines

Over a period of years, several road knockrating test procedures have been developed. The three methods in common use at this time are the Modified Uniontown, the Borderline, and the Modified Borderline procedures. In all three methods, the road-octane-number rating of a gasoline is equivalent to the octane number of the blend of primary reference fuels which matches the knocking tendency of the test fuel under comparable operation conditions.

TABLE 1—Laboratory Knock Test Methods

Operating Conditions	ASTM Motor	ASTM Research
Engine speed, RPM	900	600
Mixture temp., °F	300	125
Coolant temp., °F	212	212
Spark advance, ° BTDC	Variable with compression ratio	13

The Borderline and Modified Borderline procedures utilize the relationship between ignition timing, engine speed, and a fuel's knocking tendency to produce curves that give a graphical idea of that fuel's ability to tolerate spark advance throughout the engine speed range. These two procedures are often considered primarily as research tools for use in the development of gasolines with satisfactory antiknock characteristics over the normal range of engine speeds. They will be explained in more detail later.

The Modified Uniontown procedure is generally considered to be the best indication of a motorist's evaluation of the antiknock quality of a gasoline. This method, however, does not give complete information regarding the knocking characteristics of a

Meet the Authors

Mr. Alspaugh

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Mr. Hall

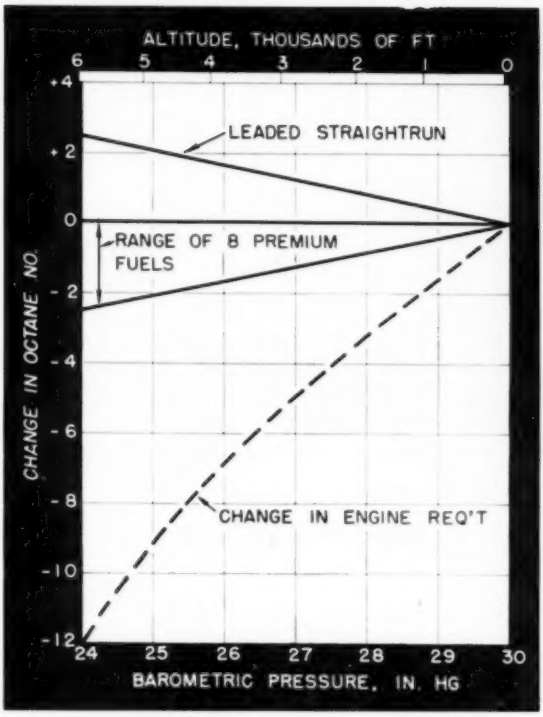


Fig. 5—**Left:** effect of change in barometric pressure on road ratings, 1950 Car M

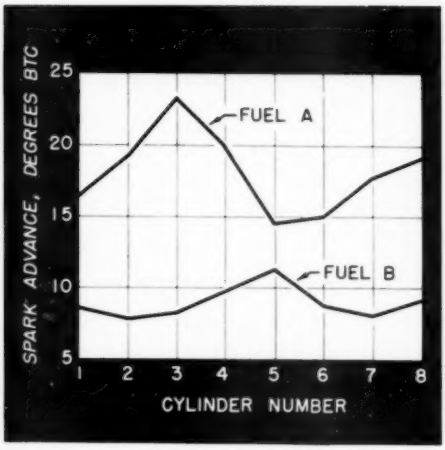


Fig. 6—**Above:** spark advance for "trace" knock, 1949 engine, 800 rpm., full throttle, 80° F. air

gasoline over the engine speed range, but only a single rating obtained at the speed of maximum knock. It is believed, however, that a motorist is more concerned about whether or not a fuel knocks; if it knocks, he is interested in the duration of the knock rather than in the speed at which detonation occurs.

Modified Uniontown Procedure

The instrumentation required by Modified Uniontown Procedure is a device for adjusting basic ignition timing, and reliable means for measuring both basic timing and vehicle or engine speed. In this procedure, fuels are rated during a full-throttle acceleration (generally from 8 to 60 mph), and the basic setting of the standard spark advance curve is adjusted (advanced or retarded) to give "traced" knock intensity at the speed of maximum knock for each test fuel and each reference fuel blend. "Trace" knock, incidentally, is defined as the first audible knock that can be readily reproduced.

A curve of reference fuel octane number versus basic ignition timing for trace knock is first developed, as shown in Fig. 2. Using a curve such as this, the road antiknock rating of a test gasoline may then be obtained in terms of octane number of the reference fuel blend which gives trace knock intensity at the same basic ignition timing. In Fig. 2, for example, Fuel "A", which required a basic ignition timing of 4 degrees before top center to produce trace knock, would be given a rating of 73 octane number, while Fuel B, with its trace-knock spark advance of 11 degrees before top center, would rate 80.

Factors Influencing Road Ratings

Fuel technologists engaged in the road antiknock evaluation of gasolines have to contend with several factors which may influence the road rating of a given fuel. Some of these factors are; make of engine, ignition timing, fuel maldistribution and variations in temperature, humidity, and barometric pressure.

Effect of Car Make on Road Ratings of a Given Gasoline. As has already been pointed out, it is highly desirable to rate gasolines on the road if truly meaningful results are to be obtained. The question then arises: "How many cars must be used to rate a given gasoline in order to establish a realistic average road rating?" Fig. 3 illustrates another phase of this problem: the need for proper selection of makes of cars. In this figure, road-octane-number ratings (as determined by the Modified Uniontown Procedure) for three different commercial gasolines that have the same Research rating of 88 have been plotted for the various cars in which ratings were made. If Fuels 21 and 39 had been rated only in Car A, they would have appeared to be equal in regard to road antiknock performance. However, ratings made in the remaining six cars showed that Fuel 21 consistently rated 2 to 4 octane numbers higher than Fuel 39. Fuel 56 was superior to Fuel 21 in Car A and definitely inferior in Car M, whereas the two gasolines gave approximately the same antiknock performance in the other five cars.

Because of the variations in relative antiknock performance of gasolines in different cars, it is obviously important to make road evaluations in more than one car. In fact, it is generally advisable to use four to six different makes of cars. These should include a representative portion of the car population as well as some makes which are critical from the standpoint of antiknock requirements. Furthermore, it is desirable, as will be shown later, to use cars

TABLE 2 — Laboratory Ratings of Typical Refinery Stocks

Gasoline	Octane Number Motor	Octane Number Research
Straight-run	55	55
Natural	65	65
Thermally cracked	70	80
Catalytically cracked	80	92
Catalytic polymer	80	95

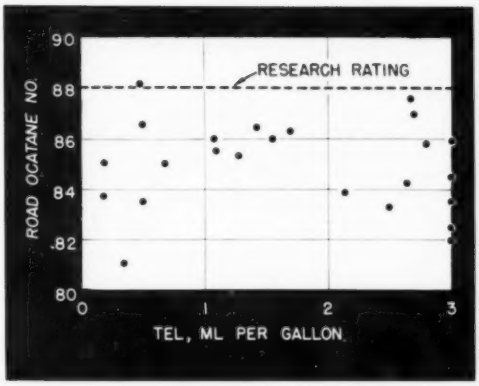


Fig. 7—Above: road ratings vs. TEL content. Fuels of 88 Research octane number; 1949 Car Q2

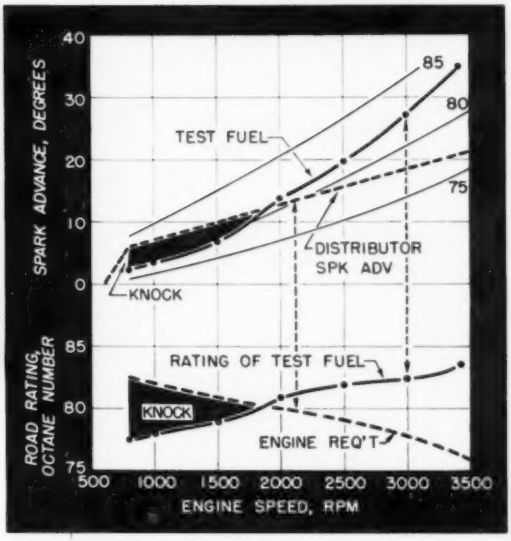


Fig. 8—Right: road rating octane numbers from Borderline Method curves

whose standard antiknock requirements are approximately satisfied by the test gasolines.

Ignition Timing. For a number of years, there has been some question regarding the reliability of road ratings obtained in cars in which an excessively retarded or advanced ignition timing setting had to be used in order to obtain the rating of a given gasoline. In other words, "Are the road ratings of high-octane-number gasolines obtained in cars requiring a spark-advance setting of 10 or more degrees above the standard timing curve as reliable as those made on the same gasoline in cars which rated the gasoline at a normal ignition setting?" Similarly, "Are the road ratings of lower-octane-number fuels made in cars requiring a retarded spark setting of 10 or so degrees below standard as reliable as those made in cars using normal ignition settings?"

Road ratings obtained in a given car on a series of fuels of wide range of octane number indicate that ignition timings required to rate these fuels may actually have an effect on the relationship between their Research and road ratings. Fig. 4 shows, for three makes of cars, the effect of a wide range of basic ignition timings on the road depreciation of fuel, i.e., the amount their road ratings are below their Research ratings. In Car F2, the relationship between the Research and road rating is not changed significantly by advanced or retarded basic-timing settings. In Car Q2, however, the lower-octane-number gasolines, rated at retarded basic spark advances, show as much as 6 octane numbers difference between Research and road rating, while the road ratings of the higher-octane-number gasolines, when rated at advanced basic ignition settings, approach their Research ratings. Car E1 shows an ignition timing effect exactly opposite to Car Q2. In this car, road ratings of the lower-octane-number gasolines, rated at retarded ignition settings, are closer to their Research ratings than corresponding values for the higher-octane-number fuels rated at advanced ignition settings.

These data indicate that, in order to minimize the effects of extreme ignition timings, premium fuels should be rated in cars which require these high-octane fuels, and regular-grade fuels should be rated in lower requirement cars.

Atmospheric Variables. Data accumulated over a period of years indicate that changes in temperature, humidity, and barometric pressure may affect the road ratings of gasolines as well as the octane-number requirement of engines. The effect of these variables on the octane number requirement of engines has been covered in a number of papers, one of the more recent of which is by Gibson.[1] In a limited number of recent tests conducted by the Ethyl Corp. Research Laboratories and designed to show the effect of temperature and humidity on road ratings, it was found that the exact magnitude and direction of changes in road ratings seem to be dependent upon both fuel type and make of car. For one car-fuel combination, for example, these preliminary tests showed that changes in ambient air temperatures from 50 to 90° F. or changes in humidity from 30 to 110 grains affected road ratings as much as 4.5 octane numbers at the 90 octane-number level.

Incidentally, the Ethyl Corp. Research Laboratories have recently placed in operation, as a service to refiners, two "all-weather rooms" in which temperature and humidity can be controlled over a wide range. In these rooms are chassis dynamometers whose sensitive controls enable accurate simulation of car speeds (including wind velocity) and road grades. Because of the elimination of the weather variable, plus the convenience of road-rating fuels indoors, away from traffic hazards and noise, road knock ratings obtained in these rooms are more reproducible than those from open-road tests.

The effect of changes in altitude (with the corresponding changes in barometric pressure) on the road rating of gasolines and vehicle octane-number requirement are shown in Fig. 5. Eight commercial premium-grade fuels, all having approximately the same Research octane number, were rated at several different altitudes from sea level to 6000 ft. The road ratings of the premium fuels varied from no change to a decrease in rating of 2.5 octane numbers for a change from 30 to 24 in. Hg barometric pressure. For this same change in barometric pressure, the octane number requirement of the vehicle was substantially reduced. It should be pointed out that these results were obtained in only one car, and that the ambient air temperature varied with the altitude in these tests. However, the results agree in general with data obtained in single-cylinder engines operated under closely controlled conditions at the Bureau of Standards.[2]

Maldistribution. It is well known that the fuel in the intake manifold of a multicylinder engine is usually

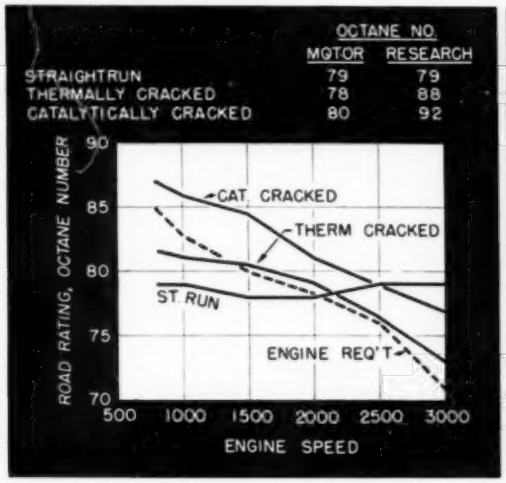


Fig. 9—Borderline Method road ratings for typical refinery stocks

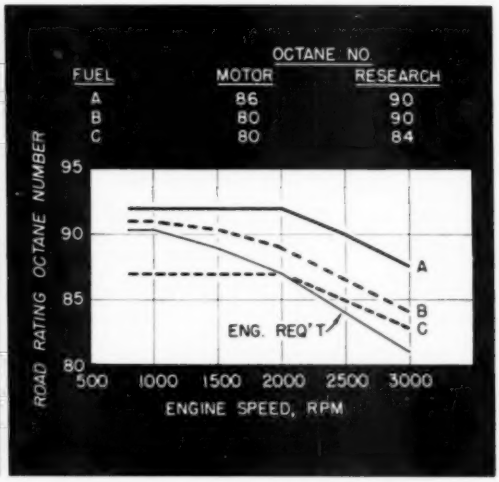


Fig. 10—Borderline Method road ratings for commercial gasolines

composed of both vaporized and liquid fuel. Due to this, as well as to other factors, maldistribution of the fuel occurs, and it is possible to have unequal amounts of whole fuel reaching individual cylinders of the engine, thus causing a variation in fuel-air ratio among the cylinders. In addition to this, each cylinder may not receive the same ratio of vaporized to liquid gasoline, with the resultant effect of having different fuels in the various cylinders. Since the road rating of a gasoline is determined by the first cylinder to knock as ignition timing is advanced, these maldistribution effects may, under certain conditions, have a decided effect on the road rating of a gasoline.

The quantitative effect of these fuel maldistribution factors on the ratings of present-day commercial gasolines is not known. Investigations are now in progress to study this effect, and data obtained so far indicate that all fuels are not affected to the same extent. Fig. 6 shows the results of testing two widely different (hydrocarbon-type composition) fuels in a 1949 passenger car engine at a constant low-engine speed which is conducive to maldistribution. The variation in spark advance for "trace" knock from cylinder to cylinder was only 3 degrees for Fuel B. Fuel A, however, showed a variation of 9 degrees. It may be observed that the road antiknock rating of Fuel A in this instance is limited by the knocking tendencies of cylinders 5 and 6.

These data indicate the need for further research on engine induction systems as well as on gasoline composition in order to achieve optimum antiknock performance on the road.

Variation in Road Ratings Among Fuels of Same Research Rating. As was previously shown in the discussion of Fig. 1, the Modified Uniontown road ratings obtained from Car Q2 for a series of 88 Research-rating gasolines varied as much as 5 to 7 octane numbers. Furthermore, Fig. 1 showed that this large variation could not be accounted for by differences in the Motor Method octane number of these fuels. In order to determine if TEL content was a factor, these same road ratings have been plotted against the TEL content of the individual fuels in Fig. 7. It is obvious from this plot that the variation in the road ratings of these fuels is independent of the TEL content.

Similar data have been obtained by the Ethyl Corp. Research Laboratories on other makes of cars as well as at other Research-octane-number levels. Further analysis has shown that the variations in ratings cannot be accounted for by differences in the engine speeds at which the gasolines are rated, nor by differences in sulfur content or other characteristics that may be shown by routine fuel inspection tests. There is, however, a definite indication that the hydrocarbon composition-TEL combination of some of these gasolines is such that they give road antiknock performances that are superior to those obtained with other fuels of the same laboratory ratings.

Road Test Procedure Used in Research and Development

The road data presented in the first part of this paper were obtained by the Modified Uniontown Procedure and concerned the antiknock evaluation of commercial gasolines. However, in programs involving fuel research and engine development work, there is a definite need for road-evaluation techniques which give more complete antiknock information. One of the most important factors affecting knock characteristics is engine speed, which is not taken into account in the Modified Uniontown Procedure. Since the knock intensity produced by a gasoline at any given engine speed varies with ignition timing, it is desirable to study the relationship between ignition timing, engine speed, and knocking tendency. Based on the suggestions of interested laboratories, a method for examining this relationship was developed in 1940 by the Coordinating Research Council. This method is known as the Borderline Procedure (CRC Designation F-8A-943).

Borderline Procedure

In conducting tests by the Borderline Procedure, some special equipment is necessary, such as a suitable device for adjusting the spark advance, means for determining both spark advance and engine speed during operation on the road, and a special distributor in which the automatic advance mechanism is inoperative.

The procedure for determining the Borderline curve for a gasoline is as follows. After the car has run for a sufficient time to insure that all operating temperatures have stabilized, the test gasoline is introduced. Ignition timing is then set manually to a relatively low advance, usually 2 to 6 degrees before top dead center. The car is slowed to as low a speed as is possible in high gear,

generally about 500 to 650 rpm, and then accelerated with wide-open throttle; the speed at which the knock dies out is noted. This yields one point on the Borderline curve, representing the two dimensions, spark advance and knock-die-out speed. The timing then is advanced 2 degrees and the entire procedure repeated to give a second point on the curve. This process is continued until the complete curve has been established for the spark advance and engine-speed range under consideration.

Borderline test data usually are plotted as shown in upper part of Fig. 8, in which the heavy (solid) line represents the test fuel's Borderline curve. The light dashed line represents the distributor spark advance curve for the particular engine in which the tests were conducted. Borderline curves for the various reference fuel blends are shown as light solid lines; the octane numbers of the blends are given adjacent to these curves.

For a gasoline to give knock-free performance in this car, it must be able to tolerate at least as much spark advance at all speeds as that produced by the distributor-advance mechanism. Wherever the solid line representing the Borderline curve for the test gasoline falls below the distributor-spark-advance curve, the engine is considered to be knocking. The Borderline curve for the fuel in Fig. 8 indicates that the engine in question will knock in the range from 700 to 1800 rpm. Incidentally, the Borderline curve obtained in this way is indicative only of the antiknock characteristics of the test gasoline in the particular type of engine used and under the test conditions employed.

The road-rating octane number of a gasoline at any speed can be obtained by interpolation between its Borderline curve and the reference fuel framework and can be plotted as shown in the lower part of Fig. 8. The engine's octane-number requirement at any speed may also be obtained by interpolation between the distributor-spark-advance curve and the reference fuel framework.

Some laboratories are now using a slightly different version of this method, known as the Modified Borderline Procedure (CRC Designation F-8B-943). The principal difference between the two methods is that points obtained by the Borderline Procedure define a curve of knock-die-out speeds versus spark advance, whereas the Modified Borderline Procedure yields a curve of spark advance for trace knock intensity over the speed range. The curve in the Modified Borderline Procedure is obtained during one full-throttle acceleration. The ignition timing is adjusted during the acceleration to give continuous "trace" knock intensity throughout the engine speed range. The principal advantage of this latter method is in the speed of making the ratings; however, its use generally requires one extra observer. It has been our experience that these two Borderline procedures generally give comparable results.

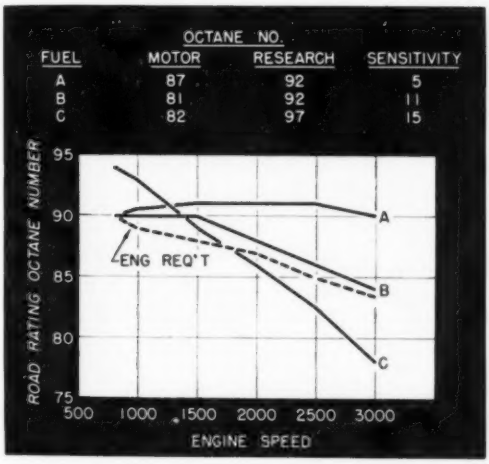


Fig. 11 — Borderline Method road ratings for gasolines of different sensitivities

The various factors that may affect Modified Uniontown ratings, as previously discussed, may also affect Borderline or Modified Borderline ratings. To date, however, very little quantitative information is available which shows the effects of atmospheric and other variables on Borderline ratings.

Borderline Ratings, Their Relation To Laboratory Ratings

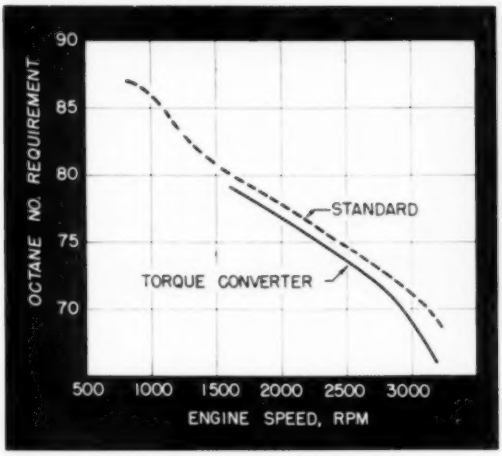
It is now well established that the hydrocarbon-type composition of a gasoline has a marked effect on its road antiknock performance throughout the engine speed range.[3] Space does not permit a detailed discussion here of the effect of hydrocarbon-type composition on the Borderline road ratings of fuels. It should be pointed out, however, that the Borderline ratings of gasolines shown in the following figures are influenced by the hydrocarbon composition of the fuels themselves. The more unsaturated nature of the cracked gasolines compared to the straight-run gasoline is indicated by their higher sensitivity, as measured by their laboratory ratings.

Borderline road ratings of three typical refinery stocks are shown in Fig. 9. These curves show that the two cracked gasolines have considerably better low-speed antiknock performance than the straight-run gasoline. As engine speed increases, however, the road ratings of the two cracked gasolines fall off rapidly, while there is no significant difference in the road rating of the straight-run gasoline throughout the entire speed range. The catalytically cracked material has the highest laboratory ratings and gives the highest road ratings except for speeds above 2500 rpm. However, it should be carefully noted that an engine's octane-number requirement also falls off with speed, so that as long as the rating of a gasoline is above the octane-number requirement of the engine, the antiknock quality of the gasoline is satisfactory for that engine.

If road ratings of gasolines having the same Research octane number are compared, the one with the highest Motor Method (less sensitivity) will generally give the best road antiknock performance throughout the speed range when evaluated by the Borderline Method. To illustrate this point, the Borderline road ratings of three commercial gasolines are shown in Fig. 10. Fuels A and B have the same Research octane number of 90; however, Fuel A has a higher Motor octane number than Fuel B and gives the highest road rating throughout the speed range. It is especially superior to Fuel B in the high-speed range. Similarly, while Fuels B and C have the same Motor octane number of 80, Fuel B yields a superior road antiknock performance, especially in the low speed range, because it has a much higher Research rating than Fuel C.

These curves show that both the Motor and Research ratings of a gasoline are of some value in indicating its road antiknock characteristics in the high- and low-speed ranges, respectively. Often, extremely sensitive gasolines may show such a rapid decline in road antiknock performance with increasing engine speed that they have a pronounced tendency to knock at high engine speeds. This is

Road Antiknock Performance



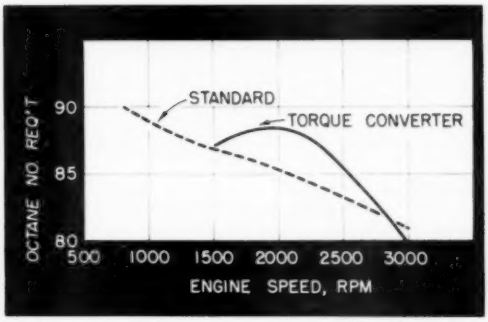


Fig. 12—Left: Octane number requirements for standard and torque-converter transmissions, Car D

Fig. 13—Above: Octane number requirements for standard and torque-converter transmissions, Car E1

illustrated in Fig. 11, which shows the effect on road ratings over the engine speed range of increasing the sensitivity of gasolines. Fuels A and B both have the same Research rating and satisfy the engine requirement over the entire speed range, with Fuel A having an excess of antiknock quality in the high-speed range probably because of its higher Motor octane number. Fuel C has a very high sensitivity of 15 units; however, it fails to satisfy the engine antiknock requirements at speeds of above 1800 rpm, although its Motor octane number is 1 unit higher than that of Fuel B. Therefore, it must be concluded that sensitivity alone is not a guarantee of satisfactory road antiknock performance.

The foregoing shows that the Research and Motor octane numbers of a gasoline are indicative of its low- and high-speed antiknock performance, respectively. The fuels which give the best road performance throughout the speed range are generally those which, for a given Research rating, have the highest Motor ratings. Furthermore, very highly sensitive fuels may give inferior high-speed performance even where they have a reasonable Motor octane number.

Automatic-Type Transmissions

Many predictions have been made on the effects of the various types of automatic transmissions (Hydramatic, torque converters, modified torque converters, and fluid drives) on fuel antiknock requirements of engines. However, actual data showing these effects are limited, despite the increasing trend toward the use of these transmissions.

In most cars equipped with standard transmissions, the low speed range—800 to 1600 rpm—is generally the most critical with respect to antiknock requirements. In view of this it might be expected that any type of automatic transmission which would eliminate or greatly minimize full-throttle operation at low engine speeds would substantially reduce the maximum requirement of the engine. However, comparisons made in cars equipped with both standard and torque-converter transmissions show that this is not always true.

Fig. 12 shows the octane-number requirement of Car D with a standard transmission and with a torque-converter transmission. At speeds above 1600 rpm, these curves show no significant difference in octane-number requirement of the engines. The maximum octane-number requirement, however, is lower for the car equipped with the torque converter, due to the fact that the engine cannot be operated for sustained periods of full throttle at the lower speeds.

Fig. 13 shows the antiknock requirements of Car E1 with a standard transmission and with a torque-converter transmission. The results obtained in this car are considerably different from those obtained in Car D. The maximum octane-number requirement of this engine has not changed significantly because of use of the torque-converter transmission. The main difference in this case is that the speed at which the engine is most critical with respect to antiknock requirement has shifted from 800 to 2000 rpm.

Few direct-comparison data are available on other types of automatic transmissions.

Summary

The road antiknock performances of gasolines cannot always be predicted accurately from their laboratory ratings. In order to obtain a realistic road rating of a fuel, it is necessary to make ratings in a number of makes of vehicles whose antiknock requirements it is intended to satisfy.

The reasons for large variations in road ratings (at least four or more octane numbers) in a given car for fuels of equal Research octane number are not fully understood. The differences in the Motor Method ratings of these fuels do not explain the variations, nor does the TEL content appear to be a factor. In making road antiknock evaluations, the fuel technologist must recognize that changes in atmospheric conditions (such as temperature, humidity, and barometric pressure) as well as differences in car makes and ignition timings can all affect fuel ratings.

Work with the Borderline Procedure, which is used in research and development work on gasolines, has shown that the Research and Motor octane numbers may be indicative of low- and high-speed antiknock performance, respectively. Furthermore, fuels which give the best road performance throughout the speed range are generally those which, for a given Research rating, have the highest Motor rating. Very highly sensitive fuels, depending on their hydrocarbon composition, may give inferior high-speed antiknock performance even when they have a reasonable Motor octane number.

The use of the torque-converter type of automatic transmission may or may not change an engine's maximum antiknock requirement, depending on the engine.

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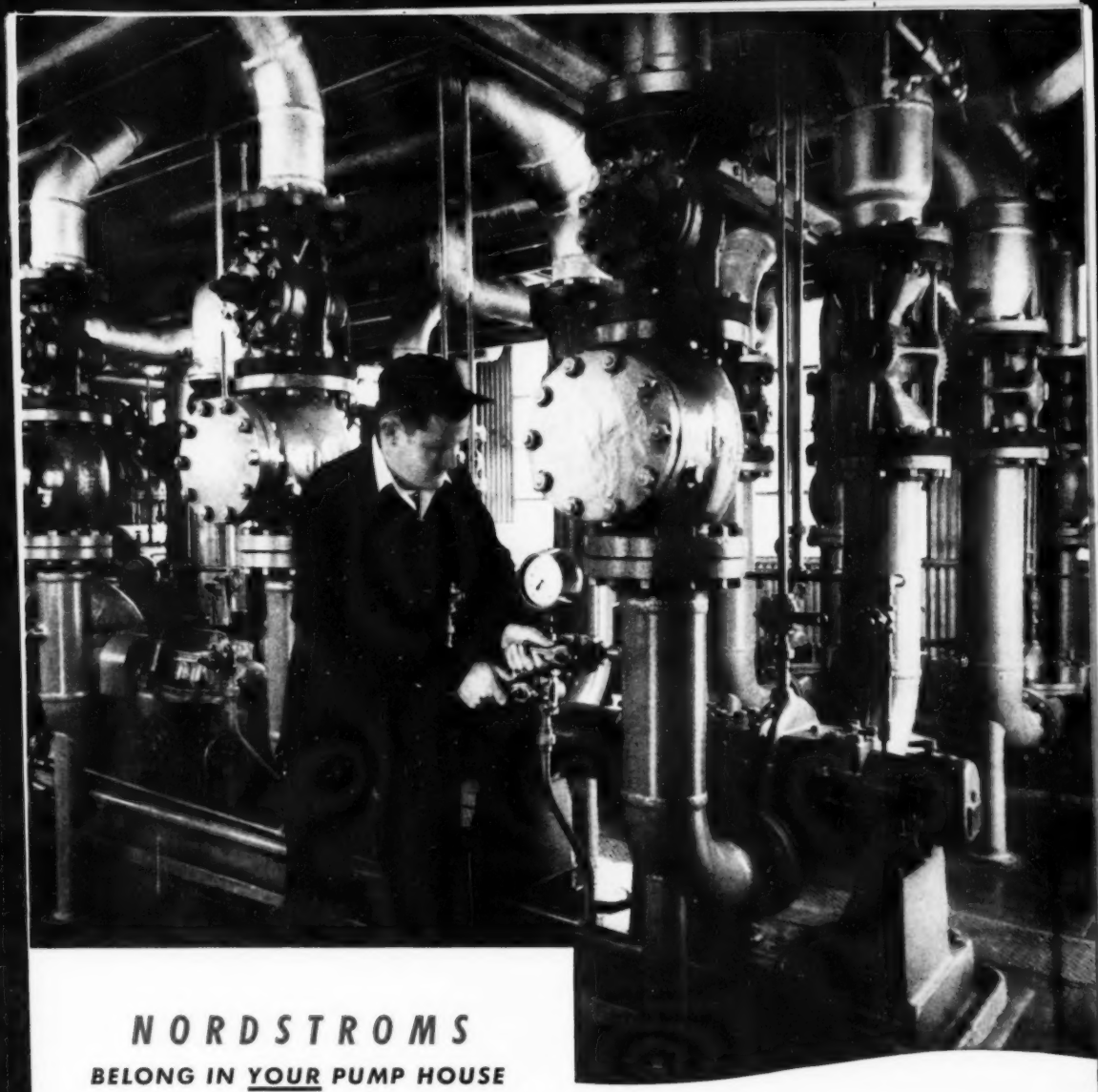

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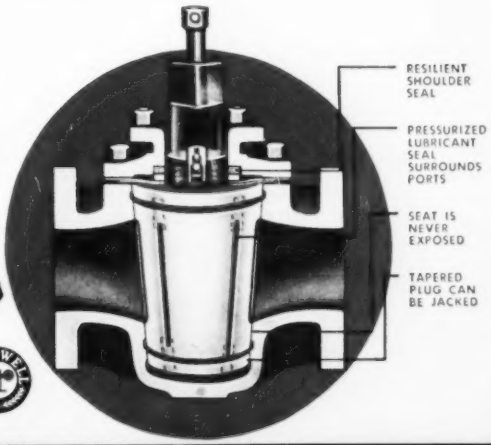

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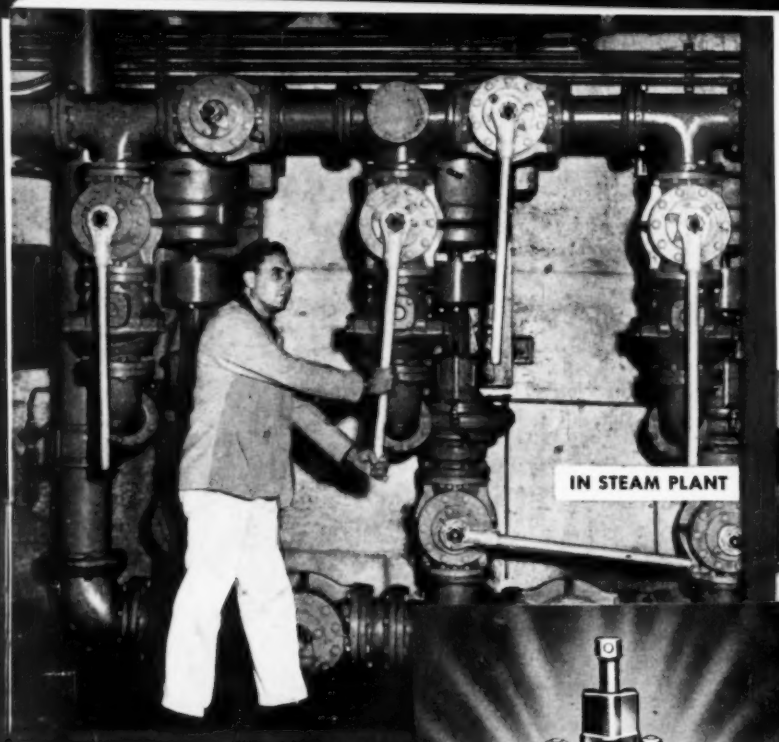

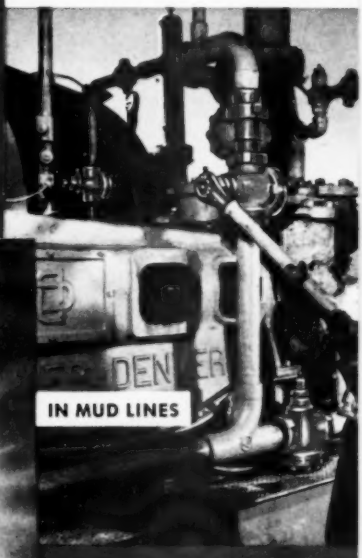

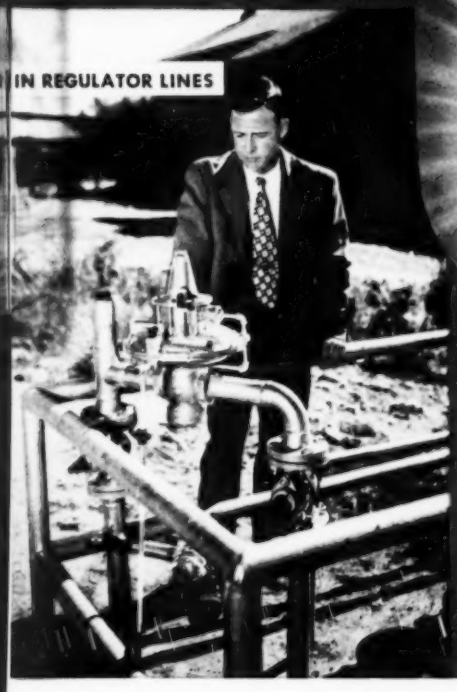

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Fight Corrosion with Plastics

Many organic polymer coatings offer help to critical alloy problem in combatting refinery corrosion

By RAYMOND B. SEYMOUR and EARL A. ERICH*
Atlas Mineral Products Co.

VIRTUALLY every plastic material available today has been tested at some time or another as a possible solution for the corrosion problems related to the petroleum processing industry.

Fortunately, the plastics industry has developed, particularly during the last decade, to the point that it can provide corrosion resistant materials which can solve many problems associated with the various processes in the petroleum industry. As a result of trial and error methods as well as continuous scientific investigations, several plastics have been selected for specific applications. These products, when properly used, have made an effective contribution to the advances in petroleum technology.

Corrosion, of course, is prevalent in practically every phase of the chemical and petroleum processing industry. Problems begin with crude oil and are associated with storage, transportation, refining, and distribution.

Specific refinery corrosion problems have been discussed by Parker[10] and linings for refinery vessels have been reviewed by Carpenter[3]. In general, the solution, of most of the corrosion problems in the petroleum field lies in the applications of the principles followed by the chemical industry[14]. That the petroleum engineer has appreciated the effects of the ravages of corrosion in the petroleum processing industry, is evidenced by the fact that the National Association of Corrosion Engineers was founded by and has always been strongly supported by petroleum engineers.

The corrosion problems associated with petroleum refining have been reviewed by Oxley[9]. These problems are similar to those encountered in other phases of the chemical industry but their severity is increased by the presence of hydrocarbon solvents. The problems associated with the storage of acid used for petroleum processing are typical and the solutions similar to those found in other industries[16].

Concentrated sulfuric acid is usually stored in unprotected steel. Hydrochloric acid is usually stored in rubber lined equipment, but a sheet lining based on a vinylidene chloride polymer gives superior results since it is not attacked by the hydrochloric acid. Neoprene cannot be used for hydrochloric acid storage since hydrochloric acid permeates the Neoprene and does not react to form a hard surface as in the case of natural rubber.

Phosphoric acid may be stored in vessels lined with sheet membranes based on natural rubber, Neoprene, vinylidene chloride, ethylene or vinyl chloride. It is important to note that protective coatings serve adequately for the protection against splash and fumes and for solvent storage but they should not be used for acid storage.

Lead linings have been used for protection against corrosion in many refinery operations. Since lead cannot be used at temperatures above 250° F., it must be protected by hard burned shale brick joined with appropriate cement. Because of their greater versatility, flexible linings discussed above are often used and are protected by brick if the temperature exceeds 150° F., or if there is danger of mechanical damage.

Because of their greater solvent resistance, linings based on vinyl and vinylidene chloride are preferred. However, when the solvents are all aliphatic hydrocarbons, Neoprene is often recommended, especially for high temperature service. The cement to be used in various processing is determined by the temperature as well as by chemical resistance. The data previously compiled for the paper industry can be used to good advantage in the petroleum industry[12]. Sulfur cements are not satisfactory in the presence of solvents or alkalies and cannot be used at temperatures above 200° F. Phenolic and furfuryl alcohol cements have excellent resistance to solvents, salts and non-oxidizing acids at temperatures up to 375° F. Phenolic cements are unsatisfactory in the presence of alkalies and while they are not completely resistant to oxidizing acids, they are superior to furfuryl alcohol resin cements for chromic, nitric and concentrated sulfuric acid.

While silicate cements must be used at temperatures above 375° F., they are recommended only when a sulfur or resin cement cannot be used. Silicate cements are not resistant to water, alkalies or hydrofluoric acid and are very readily eroded in the presence of agitation of any kind.

Storage

The interior and exterior of riveted steel tanks which are standard for the storage of crudes must be protected. In spite of apparent tightness of seams, it is often necessary to apply a solvent resistant caulking composition to the riveted area. Fortunately, a flexible product having excellent adhesion has been developed which can be applied by means of a mechanical caulking gun. This product sets by chemical action within 45 min. after it is compounded. A Thiokol base caulking material that remains permanently soft and pliable is also available for this and related applications.

The bottoms of the steel storage tanks are often protected by casting a concrete floor. In modern construction, the void left between the steel and the concrete is filled with the previously described solvent resistant caulking composition. The concrete is sometimes protected by a vinyl base coating but this is not completely essential since most of the corrosion takes place above the liquid level. Gunite linings[2], which are much denser than ordinary Portland cement linings, have been used but they are not resistant to hydrogen sulfide.

The main body of the tank is usually coated with a vinyl primer followed by four to six coats of a proprietary vinyl coating. A newer vinyl coating contains a solid rather than a liquid plasticizer and is finding considerable use as a tank coating. Neoprene coatings, which are inherently flexible, and have exceptionally high solids content, are also used in this application.

Baked phenolics[13] and plasticized phenolic resins[4] have been advocated and while the latter may be practical, baked phenolics have not been applied successfully in large storage tanks. Some of the newer acid catalyzed phenolic and furfuryl alcohol type coatings show promise for such applications and are being investigated intensively.

The exteriors of storage tanks are often coated with a heavy spray coat of a cork-filled mastic in order

* Dr. Seymour is executive vice president and technical director of Atlas Mineral Products Co., Mertztown, Penna. Mr. Erich is products director of linings and coatings for Atlas.

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to reduce evaporation of the oil stored. Additional protection against the direct rays of the sun can be obtained by spraying a top coat of a white styrene-base coating which does not dissolve the mastic.

Steel tanks with well caulked seams and lined with quality vinyl coatings are adequate for the storage or transportation of crudes or fuel. This system has proved satisfactory for tankers. The problem is not a difficult one since it requires merely a continuous coating that is not soluble in the liquid to be stored. The main difficulties are inherent in the application because of the presence of large amounts of highly toxic and inflammable solvents. Some investigators prefer coatings based on a vinylidene chloride polymer but this system does not reduce the solvent hazard. Some progress is being made in the application of aqueous dispersions for the protection of these tankers.

Because of economics and wartime shortages of steel, fuel oils and gasoline are often stored in concrete. However, because of the high porosity of even pre-stressed concrete, a satisfactory coating or lining must be used. A large number of materials have been tested by measuring the rate of loss of gasoline or other petroleum products at various temperatures[1, 11]. Vinyl coatings have proved adequate for this application[7] but, of course, possess the previously mentioned solvent hazards. Thiokol applied either as a latex or a sheet has been well accepted for this application[17]. Recent investigations have shown that blends of vinyl and Thiokol resins are superior to Thiokol latex itself. Sheet rubber based on polymers of vinylidene chloride and dispersions of other gasoline resistant plastics also show considerable promise.

Regardless of the type of structure to be protected—storage tank, process vessel, etc.—all scale, rust, and foreign matter must be removed before the application of a coating of any kind.[5] The standard method of sandblasting should be employed whenever possible and the first primer coat should be applied soon thereafter as is practicably possible. In too many cases, the sandblasting operation and coating are considered as unrelated and some sandblasted surfaces are allowed to remain as long as 24 hours before the application of the first priming coat. Possibly the best review on this subject has been written by Liebman[8] Laboratory and practical tests have shown the adhesion of a primer coat applied two hours after sandblasting to be one half that of the coat applied immediately after this operation. In spite of its simplicity, exceptional results are being obtained through the use of flame descaling but because of its inherent fire hazards, this technique is not generally used in the petroleum industry.

Good mechanical wire brushing followed by a brush application of a vinyl wash primer system will usually produce good results[13]. Several effective commercial systems are available in which this primer system is used with vinyl, styrene, furfuryl alcohol, or phenolic coatings. Even refineries that insist on using oil-type paints are finding it advantageous to use a wash primer system as the first coat.

Recent pending legislation and the earnest desire of the major petroleum firms to minimize stream pollution has resulted in a large number of problems related to solvent and corrosion resistance. The materials of construction for storage and treatment tanks associated with waste disposal are essentially the same as those discussed above. The most difficult problem is the transportation of the wastes.

Reinforced pipe based on polyfurfuryl alcohol resin is now available for transporting wastes within the plant. Pipe based on vinylidene chloride, polyester and polyethylene are also being considered but the latter is not satisfactory with aromatic solvents.

Since concrete or cast iron is not resistant to corrosion, vitrified clay pipe is almost universally used for industrial waste disposal. These pipes must be laid in stable ground or supported so that they do not settle since no flexible joint is available that is resistant to both solvents and acids. The customary recommendation is a combination joint in which a furfuryl alcohol polymer is used in the section of the pipe in contact with the liquids and the remainder of the bell cavity is filled with a hot poured sulfur cement.

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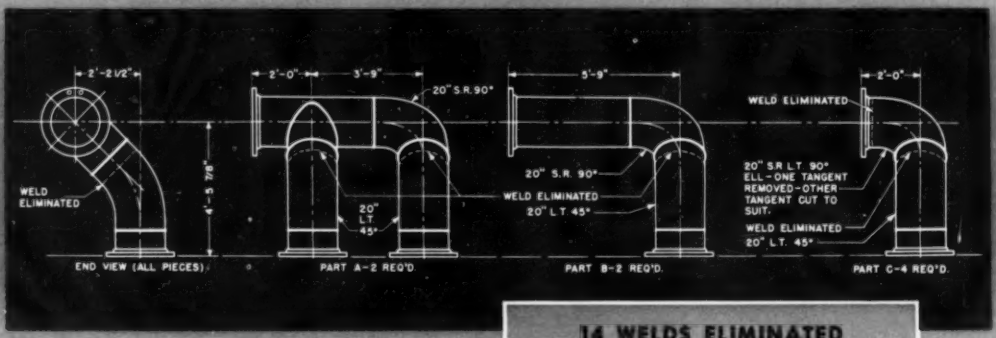

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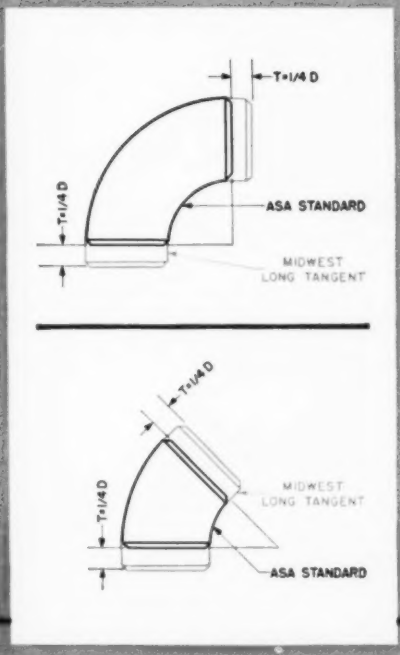

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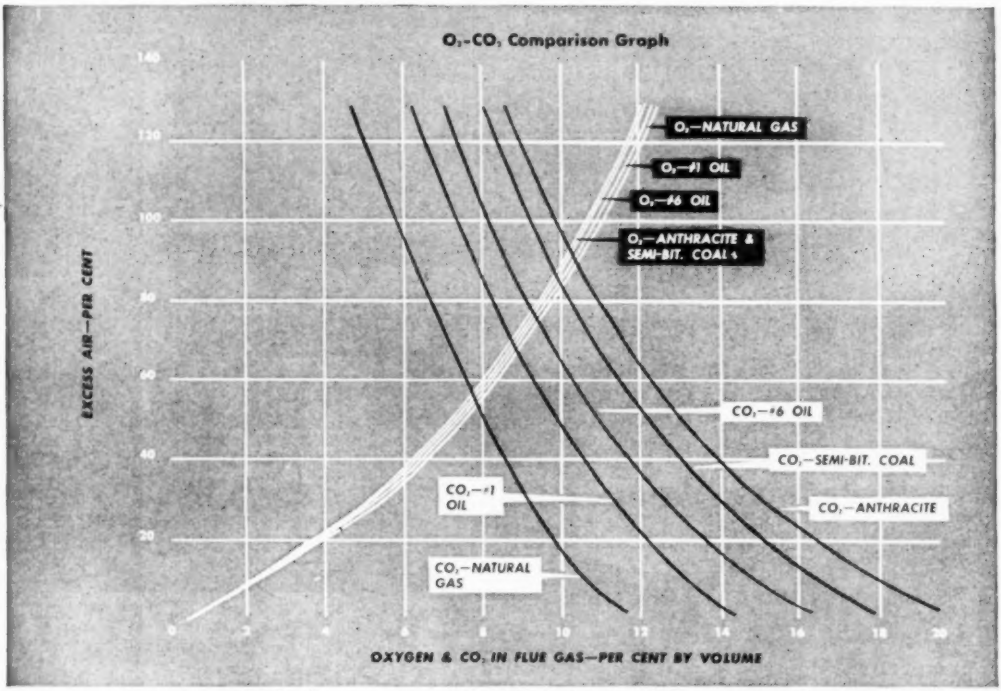

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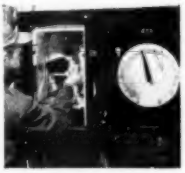

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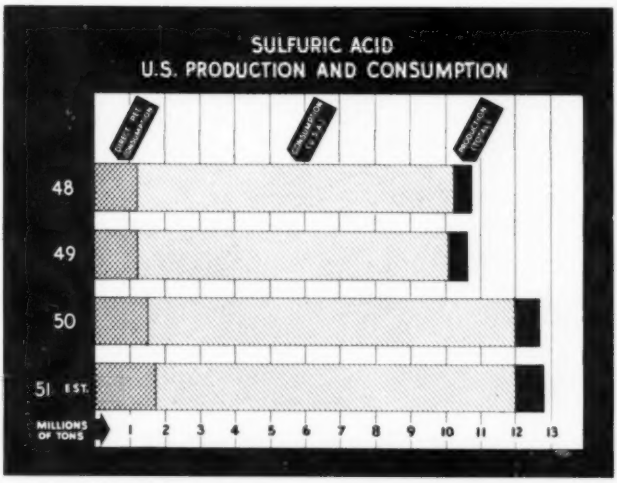

Sulfuric acid needs of petroleum refiners have increased from about 11.8% of total U. S. Consumption of the acid in 1948 to nearly 14.2% of the estimated 1951 total consumption, according to figures compiled by the Petroleum Administration for Defense

How to Conserve Sulfuric Acid

Refiners tell how they ease shortages by reusing, reclaiming spent alkylation acid

An Industry Survey
By **WILLIAM F. BLAND**
Engineering Editor

REFINERS are helping overcome current shortages of sulfuric acid threatening the industry by reusing and regenerating spent acid from their alkylation operations.

This year, according to a recent survey, the industry will require 1.7 million tons of this essential chemical. This demand figure is nearly 14% above the 1950 use (1.5 million tons), and over 40% greater than the 1949 use (1.2 million tons).

On the supply side of the picture, total production of sulfuric acid this year is expected to be about 12-13 million tons, not much of an increase over the 1950 output.

Spent alkylation acid has been found to be satisfactory in refinery treating of naphthas and furnace oils. Lube oils may be processed with spent acid providing a subsequent re-running step is used, and somewhat lower filter yields are tolerated. Waxes have been refined with spent acid, although experiences in this use have not been uniformly satisfactory.

Regeneration of spent alkylation acid is widely practiced—in their own plants by some refiners and in outside acid plants by others.

Information on what a number of refiners were doing on the reuse and regeneration of their spent alkylation acid during the last war was collected by the Technical Advisory Committee of the Petroleum Industry War Council.* The data collected at that time, however, has never been published except on a restricted basis in the classified TAC reports.

To help refiners with the problem today, PETROLEUM PROCESSING has obtained permission from the individual companies who contributed to those earlier reports to make the valuable information more widely available.

The data was supplied by a dozen refiners—Atlantic Refining Co., Gulf Oil Corp., Humble Oil & Refining Co., Magnolia Petroleum Co., Pan American Refining Co., Shell Oil Co., Sinclair Refining Co., Standard Oil Co. (Ind.), Standard Oil Co. (N. J.), Standard Oil Co. (Ohio), The Texas Co., and Tide Water Associated Oil Co.

Both Atlantic and Humble have furnished considerable new data on their present practices, Texaco and Indiana Standard revised their previous reports to bring them up-to-date, Magnolia granted permission to publish the data in the previous reports, but pointed out that it was based on "the condition as it existed at that time" and did not represent "latest practices" or "up-to-date information." Data from the other companies is that which appeared in the earlier TAC reports, approved for publication at this time.

Using Alkylation Spent Sulfuric Acid

Spent alkylation acid has been tried in a wide variety of refinery treating operations, and the comparison of effectiveness takes into account the relative chemical strengths of the used acid and of the sulfuric acid normally employed. It appears that both straight-run and cracked naphthas can be satisfactorily treated with spent acid for gum stabilization and sulfur reduction.

Furnace oils are also susceptible to treatment with this acid, several refiners reporting successful use on cracked stocks. Color and stability were satisfactory upon re-running. Two other concerns reported the use of spent acid in treating cracked gas oils, presumably for furnace oil sales.

Several companies have used spent acid for treatment of lube oils. It is believed that a cross-section of this experience indicates that odor imparted to the oil necessitates a re-running step subsequent to the treating, and that higher acid consumption

* TAC Report AMC-3, "The Second Digest of Alkylation Data," pp. 34-40, Sept. 9, 1943. TAC Report AMC-7, "Survey of Sulfuric Acid Recovery Relative to Alkylation," March 17, 1944. Both reports were prepared by the Alkylation Group of the Synthesis Subcommittee of the Technical Advisory Committee.

TABLE 1—Strengths and Amounts of Spent Acid Used for Treating Naphthas

Company	Shell	Tide Water	Magnolia
Strength, spent acid	89	90	87
Acid used, #/bbl.	1.5	**	3*

* for gum reduction; 5# for sulfur reduction 0.13% to 0.08%
** no details

TABLE 2—Comparison of Acid Treats with Recovered Acid and Spent Alkylation Acids for Color Stability of Lubricating Oil Distillates*

Type Acid Used	Reclaimed	Reclaimed	Spent Alkylation
Lbs. per bbl. Treat	11.0	11.7	11.7
% H_2SO_4 Used	98	92	92
Gravity, °API	23.5	23.3	23.2
Flash, °F.	385	385	385
Pour, °F.	15	15	15
Vis/100° F., Saybolt	227.7	231.4	232.0
Filter Yield, Bbls./Ton	57	19	21
Color, N.P.A. after 16 Hrs. at 212° F.	D 2½	D 2½	D 2½
Color, N.P.A. after filtering	L 2½	L 2½	L 2½

* Source: Magnolia Petroleum Co.

and somewhat lower filter yields will be encountered.

For wax-treating, the evidence is conflicting. One company found that spent acid could be used without affecting product quality. A second reported that the odor imparted to the drip oil was so objectionable as to preclude the use of alkylation spent acid. A third previously reported that yield and quality of refined wax were about the same for both fresh acid and spent alkylation acid, but now states that additional work has led to the conclusion that taste and odor levels in the finished product made with spent acid are so noticeable that spent acid cannot be tolerated as the treating agent.

In general, one company (Atlantic Refining) reports that it finds it advantageous to use alkylation spent acid in the treating of oils where the requirements of taste and odor are not too stringent for the final product and that such use is their present practice.

Atlantic's experience with spent alkylation acid for refining oils has covered a wide range of charge stocks, the spent acid strength being about 91%. Their acid treating operations generally entail addition of acid in several "dumps" with conditions of acid amount, treating temperature, time of agitation, time of settling, and so forth, appropriate to experience with the particular charge stock. Where odor and taste in product are not critical, Atlantic states that spent alkylation acid in many cases can be used on dumps *other than the last*. For the last dump, it is necessary to use fresh acid to effect removal of sludge floc, to control sludge fluidity, and to effect satisfactory neutralization and finishing operations.

Naphtha Treating

Both Shell and Tide Water believe spent alkylation acid to be as effective as fresh acid in treating pressure distillates on the basis of actual H_2SO_4 content. Magnolia reported no significant difference in effectiveness of white acid and spent alkylation acid of equivalent strengths used for gum or sulfur reduction. Gulf also reported the successful use of spent alkylation acid for naphtha treating, but no details were given.

More specific information on the separate types of treating appears in Table 1.

Spent alkylation acid is presently being used by Humble Oil & Refining at Baytown in the treating of light naphthas, and various studies have indicated that 50 to 60% more spent acid is required on naphthas than would be required with fresh black acid for constant quality improvement.

Humble also reports that spent acid is utilized in the treating of a part of the aromatic concentrates. A careful study of the treating requirements for this use has shown that 70% more spent alkylation acid is required to accomplish a given quality improvement than is required with fresh 98% black acid. This higher acid requirement results in 1.0% greater loss of aromatics (based on volume of aromatics charged). Further studies have shown that spent alkylation acid of 88% acidity is more effective in the treating of aromatic stocks than is concentrator black acid of the same acidity. This is probably the result of the lower water content of the spent alkylation acid of only 3.2% as compared to 12% for the concentrator black acid.

Atlantic reports that plant experience with alkylation acid for treating gasoline was satisfactory with respect to quality considerations, but that secondary sludge reactions made sludge handling difficult. Results on solvents were less favorable and the use of spent acid here has been discontinued. In general, difficulty was encountered in odor, and in color and carryover.

Straight run naphthas have been successfully treated by Magnolia, Shell, and Gulf for reduction of sulfur.

Furnace Oil Treating

Pan American reported treating of cracked furnace oil with spent acid, followed by water washing, caustic neutralization, and re-running. Parallel tests with fresh 89% H_2SO_4 and 86.3% spent alkylation acid gave identically satisfactory results when the products were compared for color stability. A 5% increase in acid sludge was found when treating with spent acid. Regular use of the alkylation acid has been in effect since 1940, and the company now reports that "we have continued the use of spent alkylation acid up to the present time and find that it works very satisfactorily."

Shell reported usage of 4-5 lb./bbl. 89% spent acid for treating #3 fuel oil. No excessive product loss or caustic requirement for neutralization has been encountered.

Humble has used spent acid for treating kerosine and heating oil for some years and now estimates that about 50-60% more treat is required with the spent alkylation acid.

Atlantic, on the other hand, reports that results on kerosine were not satisfactory and that spent acid is no longer being used for this treating operation. As with solvent treating, trouble was experienced with odor and color, ascribed in large part to contaminants originating in the alkylation B-B feed—a situation which they find not feasible to correct at present.

Lube Oil Treating

Sinclair reported that Mid-Continent lube stock (400 vis/100°) required blowing with steam and air in order to meet emulsion tests whenever alkylation spent acid was used for treating. Both Tidewater and Sinclair expressed the opinion that spent acid may be substituted for fresh acid in treating lube oils provided there is a distillation step subsequent to acid treating. Tide Water estimated that about 20% more spent acid (90% H_2SO_4) is required to produce the same effect obtained by 98% H_2SO_4.

Humble reports that treatment of lube oils requires 50% greater quantity of spent alkylation acid than of fresh black acid. Spent alkylation acid imparts an objectionable odor to many lube stocks and must be removed by further processing.

Atlantic found that in treating 100 vis. paraffin oil with 89.3% spend acid, the yields were normal and the quality was acceptable. However, the color stability was slightly lower and an odor was detected when heated at 220° F.

Magnolia's experience in the use of spent acid for treating of lube oil

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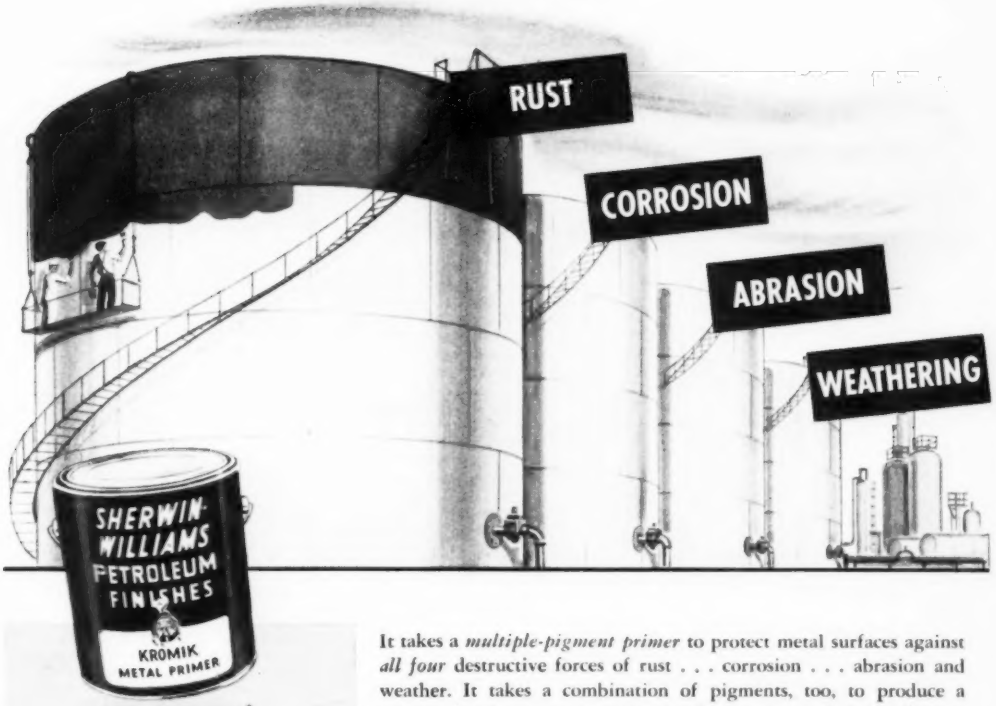

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distillate and reduced crude as reported in the TAC survey, is embodied in Tables 2 and 3.

It has been concluded that spent alkylation acid when used for treating lubricating oils gives comparable results to those obtained with reclaimed acid of equal strength. However, in practice a stronger acid would probably be used because much higher percolation yields could be obtained.

Wax Treating

Three instances of the trial use of spent acid for wax treating are known:

Atlantic Refining Co. included experimental data in the earlier TAC report on acid treating of 130° F. EMP sweated wax using 89.3% spent alkylation acid in comparison with 98% fresh acid. It was their conclusion at that time that yield and quality of the refined wax were about the same for both acids and comparable to plant results. Details of the operation follow:

First acid dump equivalent to 7# bbl. 100% H_2SO_4 followed by agitation for 30 min. at 190° F., and settling for 60 min.

The second acid dump of 14# bbl. 100% equivalent H_2SO_4 was attended by the same agitation and settling conditions as for the first dump.

A 97.8% yield of sour oil was taken, and neutralized at 180° F. with 14° Be sodium carbonate. The oil was steamed for 20 min., water washed twice, and again steamed for 20 min. After filtering through No. 1 clay at 160° F. to a yield of 75 bbls. ton, the waxes had the inspections shown in Table 4.

Atlantic now reports, however, that trial in plant equipment has led to the conclusion that taste and odor levels in the finished product made with spent acid are so noticeable that spent acid cannot be tolerated as the treating agent. This statement is qualified to the extent that it has not been established that some pre-treatment of alkylation feed stock would not bring relief. In other words, it is possible that objectionable taste, odor, and the like may be due to sulfur compounds brought into the acid either by adsorption or reaction with sulfur in the alkylation B-B feed. Pretreatment of the B-B stock, it is thought, might result in less contamination of the alkylation acid.

Magnolia reported that spent acid fortified to 93% with 98% black acid was used in amounts equivalent to black acid ordinarily employed. Product quality was the same in both cases. Use of spent acid introduced no difficulty in sludge handling.

Sinclair reported that it had tried using spent acid for treating of crude scale wax, with results as shown in Table 5. Objectionable odor was noted in drips from sweated wax made by treating with alkylation spent acid, and the conclusion was reached that spent acid would not be used for this purpose.

Recovering Spent Sulfuric Acid

The regeneration of spent alkylation acid is practiced commercially in many refineries. The following data includes (1) brief outlines of a number of acid recovery processes, and (2) descriptions of some improved modifications of these processes and other developments on sulfuric acid recovery.

Atlantic Refining Co.

Spent alkylation acid at this refinery is diluted to a strength suitable for naphtha treating or used as such for other refinery purposes. The sludges from these operations are then charged to a Chemico unit and decomposed to SO_2, which is converted to fresh strong sulfuric acid for alkylation and other purposes.

The Atlantic Refining Co. has developed a method of filtration for the clarification of weak separated acid. In this system, 18-in. to 23-in. beds, consisting of 1-in. to 4-in. layers of sand between layers of gravel, supported by a 1-2 mm. mesh screen, have been employed. The results indicate an 80-90% removal of solids from acids of about 50% sulfuric acid content containing 0.1-0.3% solids.

Gulf Oil Corp.

The Gulf Oil Corp. dilutes spent acid to the extent that the separated acid is approximately 60° Be followed by blowing with open steam for five hours, after which the acid is concentrated to 91% and fortified to any strength desired. An overall recovery of 78.8%, based on the H_2SO_4 charged to the alkylation unit, is effected.

Humble Oil & Refining Co.

Approximately 70% of the fresh acid entering the Baytown refinery is used in the alkylation process. The remainder is used in treating light and heavy naphthas and lube oils, with a small amount used in water treating. About 60% of the total acid consumed is recovered as acid of 83-86% strength for refortification by absorption of SO_3 at the Consolidated Chemical Industries plant in Houston. An additional 5% is sold as spent alkylation acid.

Recovery of any greater quantity of 83-86% acid than 60% would cause the refinery to be out of water balance; i.e., fortification to 98% would yield a quantity of fresh acid greater than that consumed in the refinery. Concentration of the recovered acid to a value higher that 86% would allow greater recovery without being out of water balance; however, with the equipment available at Baytown, concentration of acid above 86% would result in excessive decomposition.

Sludge Separation

With the exception of the sludge from treating aromatic-rich stocks

TABLE 3—Acid Treating Reduced Crude with Spent Alkylation and Reclaimed Acid*

Type Acid Used	None	Re-claimed	Re-claimed	Re-claimed	Re claimed	Spent Alky.	Spent Alky.
Lbs. per Bbl. Treat		30	40	30	40	30	40
% H_2SO_4 Used		98	98	92	92	92	92
Gravity, ° API	28.3	30.5	30.9	30.2	30.7	30.2	30.2
Flash, ° F	275	280	280	280	280	285	280
Color, Diluted T.R.		3½	3¼	3½	4½	3½	4½
Pour, ° F	50	65	60	65	65	65	65
SUV/210° F	48	45.8	46.1	45.7	45.7	45.8	45.9
Carbon Residue	1.87	0.70	0.65	0.85	0.71	0.78	0.76

* Source: Magnolia Petroleum Co.

TABLE 4—Finished Refined 130 EMP Wax Inspections*

	Stock Sweated Wax	Finished Wax from Plant 98% H_2SO_4	Finished Wax from Alkylation Pilot Unit H_2SO_4
Gravity, ° API	42.8	43.5	43.6
Color, Lovibond		10	20
Melting Point, ° F	131.6	131.4	131.2
Tensile Strength # sq. in.	123	134	127
Oil and Moisture		Nil	Nil
Odor and Taste		(O.K.)	(O.K.)
USP Carbonizable		40	20

* Source: Atlantic Refining Co.

and a portion of that from heavy lube stocks, all sludges produced at Baytown are processed for acid recovery. Light oil sludges produced from naphtha and heating oil continuous acid treating units are combined before separating. These sludges are not stored but pass directly from the treating units into the bottom of the separating kettle, where they are immediately hydrolyzed. The acid from this operation is usually about 45% strength and contains 3 to 4 lbs. of combined carbon per 100 lbs. of acid.

Some difficulty was experienced originally when spent alkylation acid was separated by itself. The large amount of heat generated distilled a part of the liquid and produced obnoxious fumes in the sludge kettle area. This difficulty has been overcome by using separated weak acid from other sludges to hydrolyze excess spent alkylation acid and by conducting the hydrolysis continuously rather than batchwise. This method produces higher strength weak acids for concentration. Also, because there is less water to evaporate, it greatly increases existing concentration plant capacities.

In general, sludges formerly were hydrolyzed with enough acid to produce a weak acid of about 35% strength because it was felt that this strength was optimum for producing a low carbon content. Hydrolysis of alkylation acid with water gives a minimum carbon content at approximately 50% strength, and weak acids from other sludges can be used to hydrolyze spent alkylation acid, producing a 50% strength acid containing less carbon than the weak acid entering the process.

Sludges in excess of the amount which can be hydrolyzed and concentrated while staying in water balance are burned as fuel at the boiler house. These excess sludges are selected for burning on the basis of poor quality with respect to high carbon producing characteristics or low strength producing characteristics.

Acid Concentration

The two concentration units are of different types and are used in series in order to precipitate carbon when the acid has been concentrated to about 70% strength, and to remove the precipitate before completing the concentration. One unit is the drum-type and the other is a modification of the tower-type. Both units use hot air to concentrate the acid.

The charge acid is routed first through the low-stage of the drum unit in order to cool the exit gas from the unit and then passes to the tower unit where it is concentrated to 70%. This tower unit is equipped with bottom manholes to facilitate quick removal of carbon deposits, and the acid leaving the units is settled and a considerable quantity of carbon skimmed off and subsequently burned.

After settling, the acid is charged to the high stage of the drum unit, where it is concentrated to 83-86% strength, depending on the acid balance. This system serves to remove 30-50% of the carbon in the acid charged to the concentrators.

Patents

The storaging, handling, hydrolyzing and concentrating of sludges and acids at Baytown are operated under one or more of the following U. S. patents:

2,308,163	2,379,224	2,425,584
2,330,077	2,387,519	2,487,103
2,343,791	2,414,727	2,522,475

More specific information may be obtained from these patents, which are based on experience at Baytown.

TABLE 5—Acid Treating of Crude Scale Wax*

	Regular Method	Spent Alkylation Acid
Acid Strength, % H_2SO_4	100	91
1st Dump (Cutter) # acid/bbl.	1	1
2nd Dump # acid/bbl.	...	9
Treating Loss, %	3.3	5.5
Volume 5° Be caustic gals./treat	285	410
Water wash, bbls./treat	750	910

* Source: Sinclair Refining Co.

Magnolia Petroleum Co.

(Prior to releasing the following data for publication, the company pointed out that it was based on the condition as it existed at the time it was originally prepared, 1944. It does not necessarily include the company's latest practices.—Ed.)

Excess alkylation spent acid over and above the quantities required in treating is recovered through separation and vacuum concentration. The mechanics of recovery involve: (1) separation of treating sludges in digestion tanks for maximum carbon and tar removal, (2) blending of the weak acid (approximate acidity, 30-40%) resulting from separation to 55-60% H_2SO_4 with spent alkylation acid for further carbon separation, (3) concentration of the 55-60% acid in a vacuum concentrator to a final acidity of 87-88% H_2SO_4, (4) fortification of the concentrated acid to 98% black acid with SO_3. The first three steps of the cycle are carried out by Magnolia; the fourth is accomplished in an outside acid plant.

The necessity of preparing an optimum acid charge to insure maximum utilization of the vacuum concentrator has emphasized steps 1 and 2. A weak acid (approximately 30-40% acidity and 1.5% carbon content) is prepared by successively digesting the sludges from treating first with a weak acid and then with water, the weak acid having been prepared by the water digestion of the previous batch. Spent alkylation acid (approximately 4.5% carbon content) is combined with the 30-40% separator acid and water for 55-60% acidity and then allowed to settle, producing a final carbon content of 1% or less.

The increase in capacity of the alkylation unit necessitated the utilization of spent alkylation acid in treating to as great an extent as possible in order to relieve stress on available acid recovery facilities. The following is a typical analysis of spent alkylation acid:

Gravity, °Be.	62.6
H_2SO_4 (titration), %	90.0
Carbon, %	4.4
Ash, %	0.26
H_2O, %	5.8

In developing the process of reclaiming spent acid, investigations were carried out on various separations and blendings of treating sludges and spent alkylation acid. It was found that the optimum procedure for preparing the charge acid to the concentrators involved individual separation of the treating sludges and dilution of the spent alkylation acid with the resulting weak acid and/or water to approximately 55-60% acidity for further carbon removal.

The proportion of separated weak acid, water, and spent alkylation acid charged to this final separation would depend on the amount of treating sludge available. If sufficient 30-40% acid were not available to dilute sufficient spent acid to load the concentrators, the additional charge acid would be prepared by separating more spent acid with water. Experience to date indicates that charge acid prepared in this manner can be concentrated with comparatively low evaporation capacity.

Shell Oil Co.

This company does not operate sulfuric acid recovery plants, but a few points of interest on sulfuric acid for alkylation have been reported.

A 98% black acid prepared by fortifying an 85% acid recovered from alcohol manufacture has been used for alkylation.

A 98-99% acid prepared from con-

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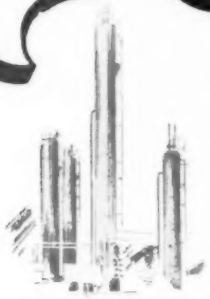

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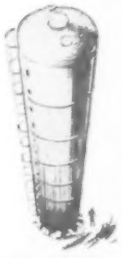

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centrating and fortifying T. N. T. plant spent acid is used at their Wood River alkylation plant and has been found to be practically equivalent to new acid.

Sinclair Refining Co.

The recovery of sulfuric acid from acid sludges resulting from acid treating or from spent alkylation acid is obtained by diluting these product residues, separating the weak aqueous acid phase and concentrating this acid phase in a concentrator employing hot flue gases to provide the necessary heat and to carry away the vaporized water.

The amount of sludge acid versus alkylation spent acid charged to the recovery plant varies with the acid requirements for alkylation and the total acid balance of the refinery. If the need for more acid is urgent at the alkylation plant, the amount of recovered and fortified acid diverted to treating light oils and lubes is reduced and these stocks then treated with spent alkylation acid. These acid charges to the recovery plant are: (1) spent alkylation acid 88% acidity, (2) sludge (50% acidity) from light oil and naphtha treating with spent alkylation acid, and (3) sludge (30% acidity) from light lube oil treating with spent alkylation acid.

The heat of hydrolyzation raises the temperature of the sludges and water in the separating kettle from about 120° F. to about 200° F. Only enough low-pressure steam for agitation is used, as cooking with steam seems to give a higher carbon content on the acid.

The flue gases enter the concentrators about 5 in. below the liquid level. The concentration of the acid from the concentrators is controlled by the rate that the weak acid is charged.

Test results on the acid at various stages in the processing are shown in Table 6.

TABLE 6—Test Results at Various Stages in the Reclaiming of Sulfuric Acid*

	Weak Separated Acid	Out Low Stage Concentrator	Out Low Stage Concentrator	Out High Stage Concentrator	Concentrated Acid	Fortified Acid
Gravity, ° Be	32.9	39.6	51.3	64.4	66.7	66.6
Ash, %	0.27	0.29	0.36	0.54	0.82	0.60
Carbon, %	0.01	0.10	0.43	0.31	0.13	0.04
Acidity, %	40.7	46.4	62.3	84.2	91.8	96.0

* Source: Sinclair Refining Co.

Standard Oil Co. (Indiana)

The sulfuric acid recovery system at the Whiting refinery consists of (a) a Chemico acid sludge coker, (b) open tank hydrolyzers, and (c) modified Chemico hot air concentrators. There are also two Chemico contact plants for make-up acid. One plant produces fuming acid from sulfur and the other produces fuming acid from the SO_2 stream of the sludge coker. All of the processes are conventional in design and operation; however, the following notes are of interest:

Sludge Coker

Raw unhydrolyzed sludges from treating operations are charged to this unit. Lubricating oil, light oil, and white oil sludges are charged to this unit which operates much more successfully on light oil and white oil sludges than on lubricating oil sludge, i.e., better on sludges containing a higher ratio of acid to hydrocarbon.

Revisions in the original coker construction have been aimed chiefly at increasing the efficiency of the gas purification system and at improving the mechanical life of the coke-handling equipment.

Hydrolyzers

Sludge produced in excess of the coker capacity is hydrolyzed and the liver (hydrolyzed sludge) prepared for boiler fuel in the following manner. Fuming acid sludge is mixed with an equal volume of water in open lead lined tanks and agitated with open steam. After settling, acid of 30-35% acidity is withdrawn for feed to a Chemico concentration unit. To the remaining liver is added one volume of gas oil, two volumes of 10-15% H_2SO_4, and two volumes of heavy motor oil sludge. This is agitated and heated with open and closed steam for 4-6 hours, a temperature of 240°-250° F. being attained. After settling, acid of about 30% acidity is withdrawn. If a more complete recovery of acid is desired, more 10-15% acid is added and the steaming repeated, but the acid separating at this point will be weaker (20-25% acidity). After separating the acid, the sludge liver is pumped to the boiler station through brass lines. Continuous agitation in the liver feed tanks ahead of the boiler is essential. Corrosion in the air preheaters is a problem even though temperatures are kept above 325° F. to minimize this difficulty. Salt deposits are also found on the convection superheaters. These deposits are removed by water washing to avoid corrosion during shutdowns.

Concentrators

The weak acid from the hydrolysis of excess sludges is concentrated in a modified multistage Chemico drum-type hot air concentrator to about 80-85% acidity. This acid may be used in place of water in the contact plant absorbers.

The chief problem of the concentrator operation is that of holding to a minimum the sulfuric acid mist which escapes the Cottrell precipitators operating on the gas stream. Control is effected by (a) operating the units in groups at three levels of acid concentration, the output acid of the lower level feeding the units of the next higher level, (b) seeking to maintain optimum acidities in the intermediate chambers of the individual concentrators, and (c) maintaining clean Cottrell tubes and electrodes.

Contact Plant

The contact acid system consists of two Chemico units operating on sulfur feed for the production of 104.5% acid, and a third Chemico unit operating on SO_2 gas derived from the decomposition and purification system of the sludge coker.

Standard Oil Co. (New Jersey)

The Standard Oil Development Co. has made available information on the sulfuric acid operations in the associated and subsidiary companies of the Standard Oil Co. (New Jersey).

Aruba Refinery—Lago Oil and Transport Co.

In this refinery the quantity of acid used for treating is considerably in excess of that required for the alkylation units. Therefore, the total fortified acid is fed through the alkylation plant and is withdrawn as spent alkylation acid with an acidity of 92-93% and this acid is used in refinery treating operations, principally for cracked distillates with a small amount being used for water white treating. The resulting sludges are separated continuously in a pressure system with the initial separation being followed by a steaming operation, also carried out under pressure. The recovered acid is concentrated in Chemico drum-type hot flue gas units and subsequently fortified in a Chemico brimstone contact plant to a final acidity of approximately 98% before return to the alkylation operation.

Baton Rouge Refinery—Esso Standard Oil Co.—Louisiana Division

Acid requirements of the alkylation units in this refinery greatly exceed the refinery acid treating needs.

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We'd like to send you a free sample of the new Fel-Pro C-5 "Hi-Temp" ThreadCompound to try on your toughest thread compound problems, including alloy and stainless steels. Then you can see the amazing, money-saving results being obtained by the nation's largest refineries, utilities and process industries. Fel-Pro's exclusive Colloidal-Copper formula keeps metal parts separated, regardless of temperatures. Its neutral action solves the alloy and stainless steel pitting problems. One utility company reports that heater dismantling time has been cut from two days to four hours, by the use of Fel-Pro C-5 "Hi-Temp". Why not see what "Hi-Temp" can do for you ... get your free sample and complete data sheet—*write today!*

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3837

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Versatile! Series C Vertical Mixers do big mixing jobs quickly and thoroughly. Their power range is from ¼ to 15 H.P. at standard speeds of 1725, 1140, 420, and 230 R.P.M. Standard NEMA ball-bearing type motor is furnished. Stuffing box is separate component and can be specified in any alloy for low original cost. Write our engineers about your mixing problem. Their service is without obligation.

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DEPT. SB

Eastern INDUSTRIES, Inc.
296 ELM STREET • NEW HAVEN 6, CONNECTICUT

Sulfuric Acid Conservation

It is therefore necessary to separate a considerable quantity of spent alkylation acid as such. This separation is carried out in atmospheric kettles, adding the spent alkylation acid to cold water with continuous pump circulation, so that the maximum temperature does not exceed 250° F. with 230° F. being the preferred maximum.

The carbon content of the weak acid varies with the quality of the spent alkylation acid separated. If the alkylation plant feed stock contains diolefins, or if the acid strength is below 90%, there is a marked increase in the carbon content of the recovered separated acid. In this refinery a portion of the spent alkylation acid is also used in treating operations and the sludges from these treats are separated in admixture with spent alkylation acid. The resulting separated acids from these operations are rather high in carbon content. Black 98% acid (same as alkylation plant feed acid) is also used for lube oil treating; the sludges from this operation being separated by themselves, giving a low-carbon recovered acid.

All recovered separated acids are combined in the tankage at the acid restoring plant. Concentration is carried out in a continuous Mantius-type high - vacuum concentrator which is heated by Dowtherm circulation. When acid feeds are low in carbon, reasonably good run lengths are obtained, but with high-carbon acids frequent cleaning of the equipment becomes necessary. The large quantities of alkylation acid required in this refinery have necessitated the rehabilitation of an existing old Chemico pan and tower type concentrator to supplement the Mantius unit.

The restored acid from the concentrating unit is shipped to a local chemical plant for fortification to 98% acidity and returned to the refinery for alkylation and treating operations.

Baltimore Refinery—Esso Standard Oil Co.

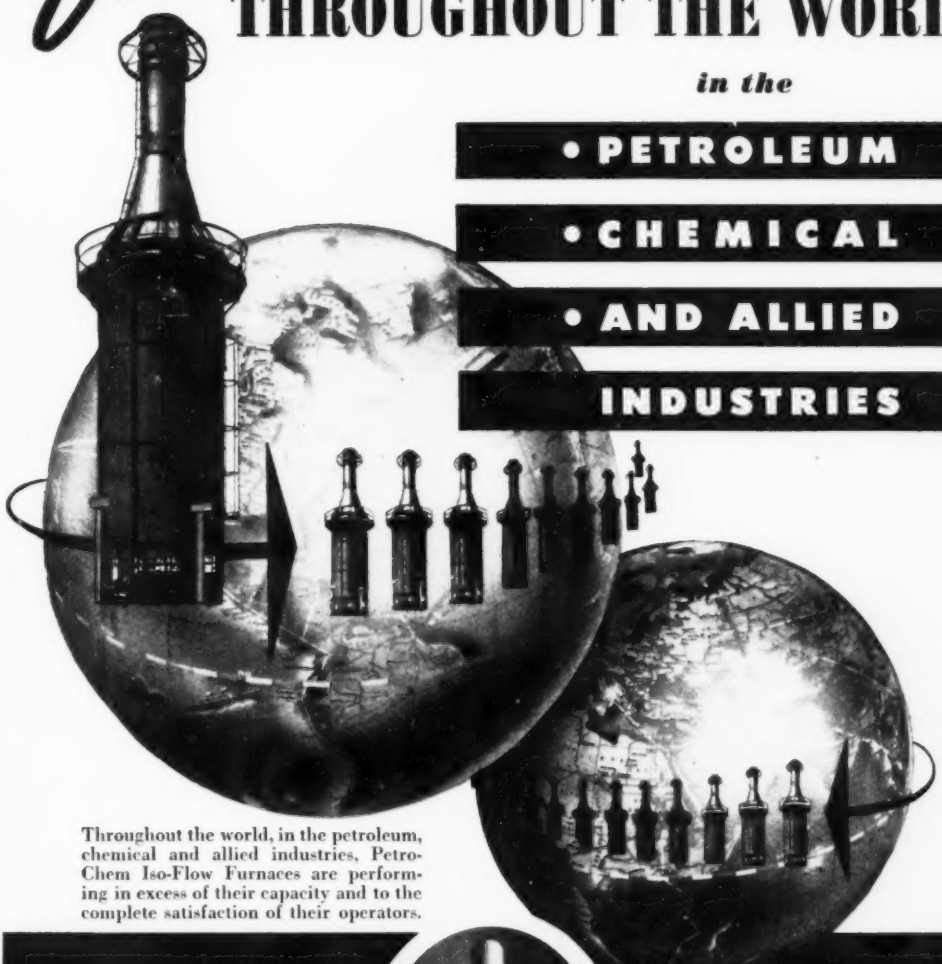
In this refinery, alkylation is practiced, but no acid recovery facilities are in operation. The acid used for alkylation is withdrawn from the system at approximately 90-92% acidity and returned to the local acid supplier for production of fertilizer.

Bayway Refinery—Esso Standard Oil Co.

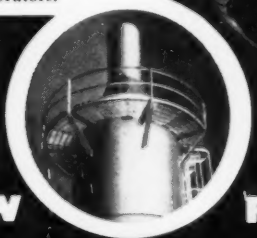
Although this refinery has no alkylation facilities, the methods of handling acid are of interest. The quantity of 93 or 98% black acid used for refinery treating is rather small and the sludges from these white products operations are sepa-

favored
THROUGHOUT THE WORLD
in the

• PETROLEUM
• CHEMICAL
• AND ALLIED
INDUSTRIES



Throughout the world, in the petroleum, chemical and allied industries, Petro-Chem Iso-Flow Furnaces are performing in excess of their capacity and to the complete satisfaction of their operators.



PETRO-CHEM
ISO-FLOW FURNACES

UNLIMITED IN SIZE ... CAPACITY ... DUTY

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 (To obtain more data on advertised products see page 908)

You can count on this sign...

for Years-Ahead engineering

The Lummus symbol stands for a group of designing engineers and constructors who make it their business to *plan ahead*—an ability which keeps them always abreast of the pace and often stamps them pacesetters.

That's why you found Lummus at the forefront in the vast synthetic rubber program. It's what made the company logical pioneers in the aviation gasoline field, with fourteen complete plants to its credit. It's what keeps Lummus in the van, wherever or however crude oil is refined.

By the same token, count on Lummus people again in the hurried and harried times ahead. Depend upon them for specialized planning that brings expanded needs into sharp focus. Rely on their record of skillful design, sound engineering, competent construction, and on-schedule delivery.

In whatever direction the upward trend of demand occurs—total crude capacity, catalytic cracking facilities, plants for making high quality aviation gasoline, petroleum chemical units—you'll find Lummus well able to fulfill the difficult requirements imposed by years-ahead engineering.

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CHICAGO • HOUSTON • LONDON • CARACAS • PARIS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

Sulfuric Acid Conservation

rated in a continuous type separator. The weak acid is restored in Chemico pan and tower type concentrators and the restored acid fortified by blending with 20% fuming acid before re-use in the treating operation.

Sludges from a second operation are processed through a Chemico sludge conversion unit in which they are broken down to SO_2, which, after purification, is converted in a typical contact acid plant to either 98% acid or 20% oleum. Losses are made up by burning of sulfur or hydrogen sulfide when the latter is available.

In a third operation, the separated acid is concentrated in a continuous two-stage Mantius type high-vacuum concentrator to an acidity which renders it satisfactory for use in the refinery operation where it is applied.

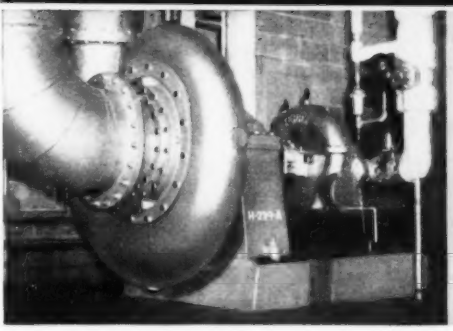
General Remarks

In general, if alkylation of butenes only is practiced and the spent alkylation acid which is withdrawn from the system has an acidity exceeding 90%, not too much difficulty is encountered in the separating and concentrating steps, since the carbon content of the separated acid is relatively low. However, when the spent alkylation acid is used for treating prior to separation, it loses its character and assumes, instead, the character of a typical sludge acid resulting from the type of stock treated. A spent alkylation acid used for treating a highly aromatic stock, for example, will, on separation, give a weak acid of a very high carbon content. This carbon content can, in some instances, be reduced by a pressure distillation step.

Regardless of whether or not vacuum or hot flue gas concentration is used, the sequence of steps necessary—separation, pressure distillation (if used), concentration, and fortification—always presents a difficult problem with regard to water balance. In those cases where treating losses are rather high, this is not too serious, but where treating losses are low it is necessary to concentrate to final acidities not always readily attainable. The result is that a considerable excess of strong acid is produced in the fortification operation to the extent that water cannot be removed from the acid system. Acid discard is possible but not economical or generally practical.

Standard Oil Co. (Ohio)

Fresh 98% sulfuric acid is charged to the Toledo alkylation plant, and the acid is spent at approximately 93% titratable acidity. Part of this spent alkylation acid is used for lube oil treating at two different locations. At one location a weak acid, approximately 35% sulfuric acid, is recovered from the lube sludge by conventional



CENTRIFUGAL

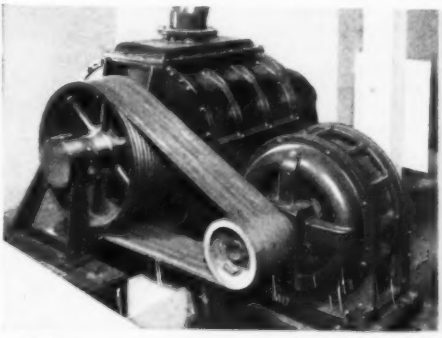
Type OIB Centrifugal Blower used for processing in a large eastern plant. Capacity 12,000 cfm. Similar R-C Blowers are utilized in other plants of this company.

The works manager of a large plant made this friendly statement to a Roots-Connersville representative. What he really meant was that R-C Blowers and related equipment perform so satisfactorily and dependably that they seldom need anything more than routine inspection by his own men.

In large and small plants, in every industry, R-C products uniformly give this kind of reliable operation. They continue to deliver rated capacities, year after year, with a minimum of maintenance—whether a small Rotary Positive Blower of 5 cfm capacity or a Centrifugal unit moving up to 100,000 cfm. And remember, only Roots-Connersville gives you this important dual-choice.

If you are planning a new plant, expansion, or replacements, R-C engineers will work with you to select the equipment best fitted to your needs. Almost a century of experience is at your service.

ROOTS-CONNERSVILLE BLOWER CORPORATION
510 Texas Avenue, Connersville, Indiana



ROTARY

R-C Rotary Positive Blower used in oil processing. Capacity 3,140 cfm.

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

(To obtain more data on advertised products see page 908)

Look to these five reasons for long, trouble-free service in STRONG 70 Series Traps:

1. *Valve and seat guaranteed leakproof for one year—made of STRONG's patented, wear-resistant Anum-Metl;*
2. *Easy servicing—permitted by the renewable seat design, cover with all working parts easily removed without breaking pipe connections;*
3. *One piece bucket—stainless steel, no welds;*
4. *Turbulence avoided, choking minimized, 25% greater capacity—with STRONG's exclusive Hi-Cap orifice;*
5. *No dribbling, quick, full opening—high ratio leverage.*

STRONG *in-line* 70 Series Traps are available in sizes from ½" to 1", semi-steel construction. STRONG's "two-in-one" blast trap with integral thermal air vent is also available in the 70 Series (see cut below).

Catalog No. 68-Q describes these traps in detail along with other STRONG traps. Write today.

*Trademark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY

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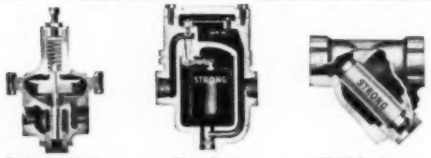
OTHER STRONG STEAM SPECIALTIES



Reducing Valve | Blast Trap | "SY" Strainer

STRONG

Sulfuric Acid Conservation

dilution and cooking methods. This weak acid is then blended with additional spent alkylation acid to produce a 60% acid. At the other location, weak acid is produced in the same manner, and then concentrated to 74% sulfuric acid content in a vacuum concentrator. The acids from both locations are sold to another company and eventually used for steel pickling.

The Texas Co.

Sulfuric acid recovery at the Port Arthur refinery consists of (a) hydrolysis of sulfuric acid sludge and spent alkylation acid by water dilution and heat, (b) separation of the weak acid from the hydrolysis step and concentration to 86-90% and (c) fortification of the concentrated acid to 98% strength by the acid supplier.

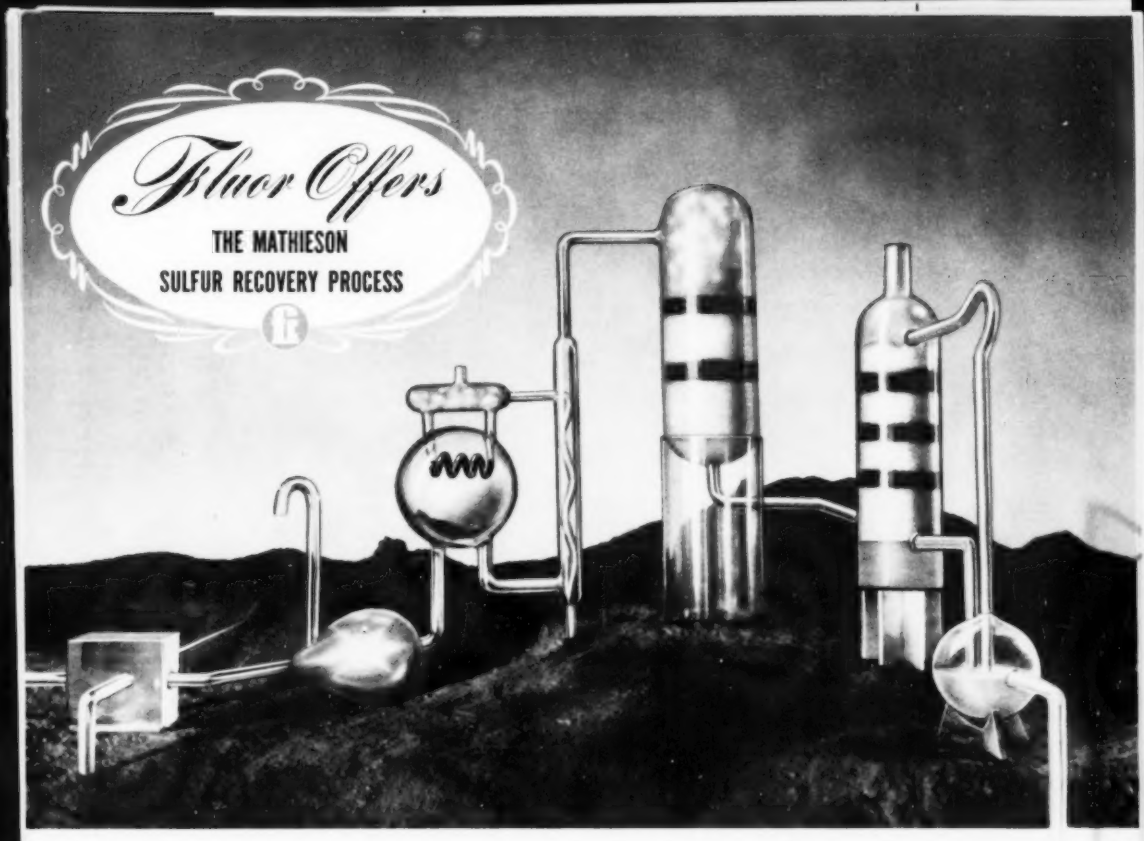
The hydrolysis step is carried out in lead and bricklined atmospheric cone-bottom separators. The separators are partially filled with water and acid is then added. Hydrolysis of spent alkylation acid is carried out at 40-50% strength, while the hydrolysis of treating sludges from lubricating oils and of sludges resulting from the re-use of spent alkylation acid for naphtha treating is carried out at approximately 30% acidity. For this reason, spent alkylation acid sludges and lubricating oil sludges are kept separate from spent alkylation acid. Sludges are hydrolyzed by blowing with open steam, which provides both heat and water to the system. It is endeavored to keep the hydrocarbon content of the hydrolyzed acid below 1% oxidizables expressed as carbon on a 100% H_2SO_4 basis.

The sulfuric acid concentrating equipment consists of two Chemical Construction Corp. tower-type units. These units are operated to concentrate acid from approximately 30 to 86%. In addition to the above units, there are two Chemical Construction units which operate almost exclusively on spent alkylation acid. These units concentrate the acid charge from 40-50% to 90% concentration, as desired.

Recovered sulfuric acid of 86-90% strength is fortified to 98% or stronger by the acid supplier.

It is desirable to reduce the carbon and hydrocarbon content of recovered acid to as low a value as possible before concentrating. It is also desirable to remove from the concentrated acid any separable carbon formed in the concentration step. To this end it has been found advisable to provide considerable tankage for settling between the hydrolysis and concentration and fortification steps.

(*To obtain more data on advertised products see page* 908)



Fluor Offers

THE MATHIESON SULFUR RECOVERY PROCESS

A simple process for the conversion of waste hydrogen sulfide to pure elemental sulfur

The availability of sulfur is rapidly becoming critical to the refining industry. First pinch was evident when sulfur and sulfuric acid were placed under allocation control by National Production Authority.

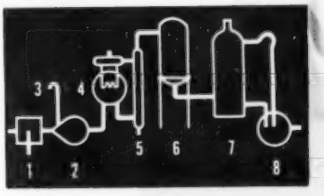
Primary cause of sulfur allocation is a gradual depletion of known deposits. Secondary cause is the great demand for sulfur in the manufacture of vital defense program materials. Mined sulfur is the normal source for such materials. The refiner, however, has in most cases his *own* potential source of sulfur.

Recovery from waste

The refiner's answer is the Mathieson Process for converting into sulfur the waste hydrogen sulfide recovered from sour petroleum gases. This simple process—available through The Fluor Corporation, Ltd.—accomplishes *two* important purposes:

1. *Guarantees independent supply* by affording each refiner an independent sulfur supply to meet his particular requirements—protection for the present, additional income for the future.

2. *Conserves for national defense* by contributing to the over-all National Defense Program in helping to conserve a critical commodity.



THE MATHIESON SULFUR RECOVERY PROCESS
Hydrogen sulfide, recovered from a sour gas stream, is partially burned with air—cooling follows with steam generated being utilized for power. Combustion gases are then passed through a catalyst tower to form sulfur and water vapor. Elemental sulfur product is condensed in a wash tower by direct contact with cooled liquid sulfur. The result is pure commercial sulfur—ready for sale or for conversion into sulfuric acid.

1—TREATING PLANT, 2—REACTOR FURNACE, 3—AIR INTAKE, 4—WASTE HEAT BOILER, 5—ECONOMIZER, 6—CATALYTIC CONVERTER, 7—SULFUR WASH TOWER, 8—RECIRCULATING SUMP

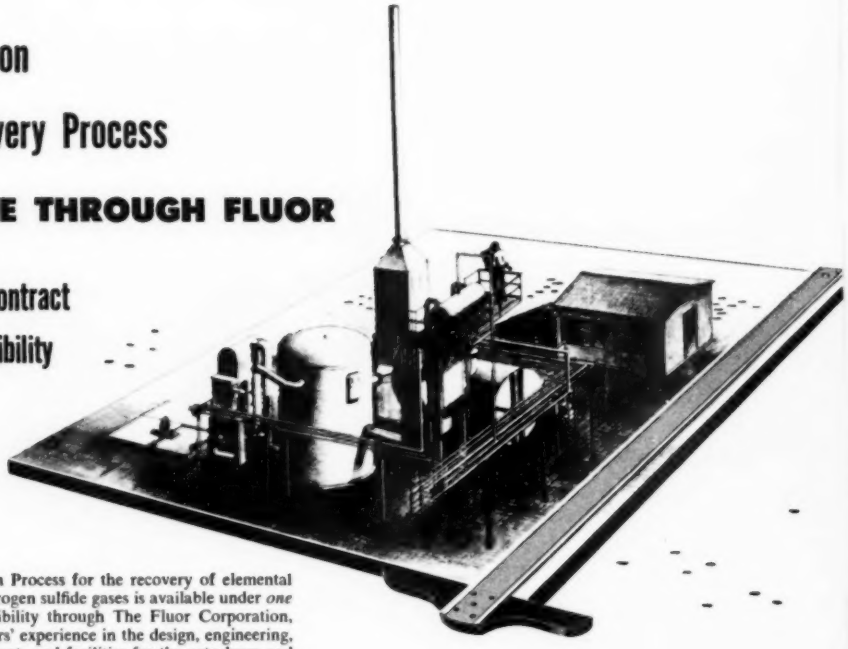
See Reverse Side

The Mathieson

Sulfur Recovery Process

AVAILABLE THROUGH FLUOR

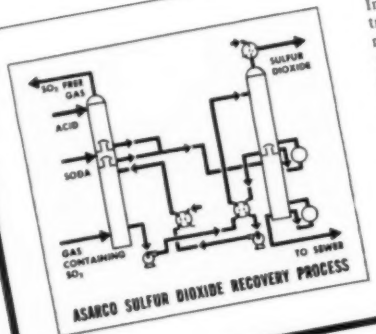
- Under ONE Contract
- ONE Responsibility



The proven Mathieson Process for the recovery of elemental sulfur from waste hydrogen sulfide gases is available under *one* contract, *one* responsibility through The Fluor Corporation, Ltd. With over 30 years' experience in the design, engineering, and construction of plants and facilities for the petroleum and chemical industries, Fluor possesses the background, the skilled personnel, and the know-how essential for the practical interpretation of the Mathieson Process into *your particular* sulfur recovery program.

Fluor is in a position to make economic studies covering every phase of proposed sulfur recovery installations--initial investment, operating costs, and returns to the investor.

A process for the recovery of Sulfur Dioxide is also available through FLUOR



ASARCO SULFUR DIOXIDE RECOVERY PROCESS

In line with Fluor's expanding activity in the fields of gas treating and sulfur recovery, arrangements have been made with the American Smelting and Refining Company (ASARCO) for Fluor to design, engineer and construct sulfur dioxide recovery plants using the ASARCO Process. Fluor's investigations have shown this process to be the most suitable of any available for the removal and recovery of pure sulfur dioxide from stack gases. In the application of the process, the gas is scrubbed with dimethylaniline which is then fed to a stripping column for sulfur dioxide recovery in a cyclic process. The resulting sulfur dioxide product may be dehydrated and liquefied for sale as liquid SO_2 or fed directly to an acid or sulfur plant.

All details including first studies are available through The Fluor Corporation, Ltd., and the American Smelting and Refining Company.

BE SURE WITH

FLUOR

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif.

New York, Chicago, Boston, Pittsburgh, Tulsa, Houston, San Francisco, Birmingham, Calgary.

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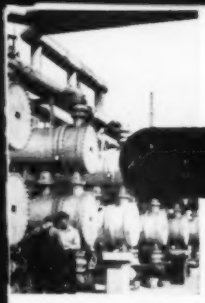
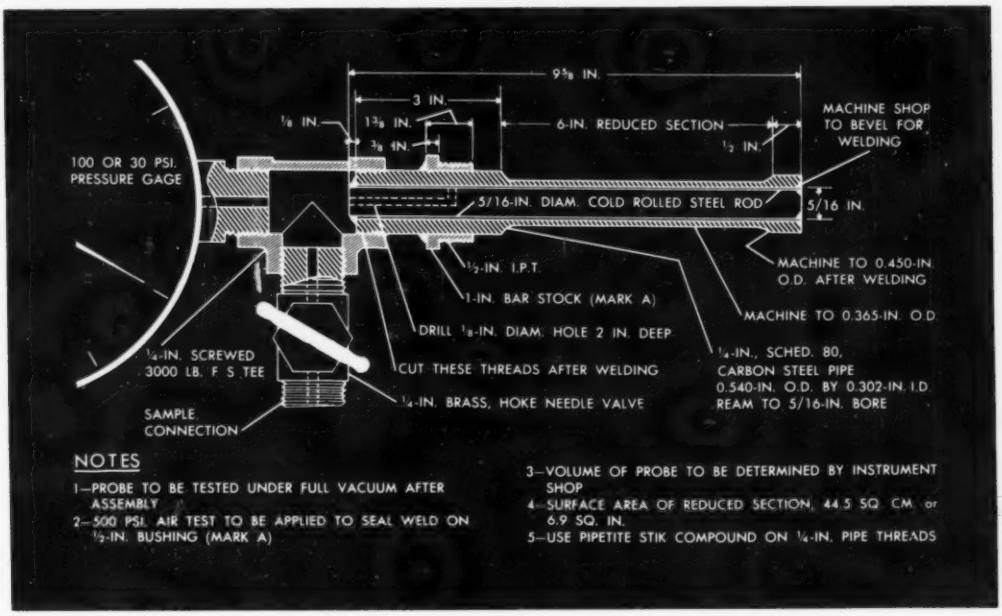


PLANT PRACTICES

Practical Tips and Ideas for Improving Operations

Easily Made Test Probe for Hydrogen Attack


9⅝ IN.
3 IN.
⅛ IN.
1⅜ IN.
⅜ IN.
6-IN. REDUCED SECTION
½ IN.
MACHINE SHOP TO BEVEL FOR WELDING
100 OR 30 PSI. PRESSURE GAGE
5/16-IN. DIAM. COLD ROLLED STEEL ROD
5/16 IN.
½-IN. I.P.T.
1-IN. BAR STOCK (MARK A)
MACHINE TO 0.450-IN. O.D. AFTER WELDING
MACHINE TO 0.365-IN. O.D.
DRILL ⅛-IN. DIAM. HOLE 2 IN. DEEP
¼-IN. SCREWED 3000 LB. F. S. TEE
CUT THESE THREADS AFTER WELDING
¼-IN., SCHED. 80, CARBON STEEL PIPE 0.540-IN. O.D. BY 0.302-IN. I.D. REAM TO 5/16-IN. BORE
¼-IN. BRASS, HOKE NEEDLE VALVE
SAMPLE CONNECTION
NOTES
1—PROBE TO BE TESTED UNDER FULL VACUUM AFTER ASSEMBLY
2—500 PSI. AIR TEST TO BE APPLIED TO SEAL WELD ON ½-IN. BUSHING (MARK A)
3—VOLUME OF PROBE TO BE DETERMINED BY INSTRUMENT SHOP
4—SURFACE AREA OF REDUCED SECTION, 44.5 SQ. CM. or 6.9 SQ. IN.
5—USE PIPETITE STIK COMPOUND ON ¼-IN. PIPE THREADS

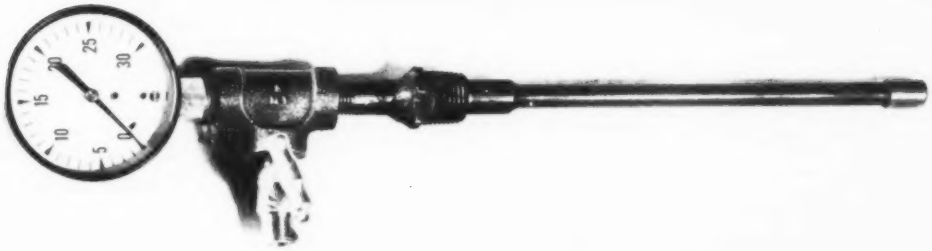


Fig. 1—Corrosion of steel by hydrogen blistering can be watched for with this standard hydrogen probe developed by Shell

INTENSIVE study of the problem of corrosion by hydrogen attack has led to the development of a standard hydrogen probe by Shell Oil Co.'s engineering department. The instrument is designed to determine conditions which promote hydrogen attack on the low carbon steels in conventional refinery process equipment and piping, which may lead to blistering and fissuring of the metal. Similar to a thermowell, the probe in use is installed in suspect areas and measures the rate of hydrogen penetration through a thin wall, or membrane, of steel, to indicate the extent of hydrogen activity in the particular environment under test.

Several types of probes have been devised in Shell's study of hydrogen blistering in steel associated with

NOW—install wear plates with a trowel

...a new way to protect equipment from erosion and corrosion

PENNSALT CHEMICALS
for Industry • Agriculture • Health • Home

Progressive Chemistry for over a Century

By combining Penchlor FCC Cement and a steel gridwork you can literally install "wear plates" with a trowel . . . thus solving the twin problem of erosion and corrosion.

The construction shown has met with outstanding success in lining fluid catalytic cracking equipment, such as cyclones, feed and return lines and large fittings. At points of severe wear the cement-steel combination withstands the abrasive action of high-velocity, fine catalyst particles and resists sulfation by petroleum gases at temperatures of 1250°F. and higher.

In addition, when you use Penchlor Grid Linings you can often design a less expensive wall section thus saving critical material by taking advantage of the wearing properties and resistance to thermal shock offered by this method.

For further information on this, or other Penchlor FCC Cement uses, write Pennsylvania Salt Manufacturing Company, Industrial Chemicals Department, 1000 Widener Building, Philadelphia 7, Pa.

5 Important Advantages of Penchlor Grid Linings

1. Replace more expensive high-alloy steels.
2. Fast "return to service"—short curing time.
3. Long life. Penchlor Linings have been in service for over 3 years without extensive repair . . . over twice the life of former linings.
4. Penchlor gains hardness while in service.
5. Penchlor offers total resistance to many corrosives.

aqueous corrosion. The instrument finally selected as standard is illustrated in Fig. 1. Essentially, it is a thin-walled section of tubing fitted over a solid steel rod. The thin wall, of carbon steel, permits rapid penetration by hydrogen. A measurable change in pressure with only a small accumulation of hydrogen is obtained by venting the annular space between tubing and rod to a pressure indicator. While providing the required sensitivity, the instrument is simple, rugged, of small size, and is economical to build.

The probe shown is fitted with a pressure gage. However, the same instrument is adaptable to continuous recording. The screwed tee and gage can be removed and a capillary tube brazed on, leading from a pressure recorder directly into the $\frac{1}{8}$-in. diameter vent hole in the rod. The device can also be modified to permit its insertion and withdrawal through a stuffing box while the vessel or pipe is under pressure.

Tested for Leaks

Prior to use, the hydrogen probes are tested for leaks, either by pressure testing with hydrogen at 100 psi. or by evacuation to about 0.1 mm. Hg., and observing any loss in pressure or vacuum after 24 hours. It is important that the probe be free of leaks, because the rate of hydrogen accumulation may be only a few milliliters per day.

The volume inside the assembled probe is determined by applying two atm. of pressure and measuring the gas released when the pressure is reduced to one atm. Knowing the volume of the probe and the area and thickness of the tubing wall, the test engineer can express the activity of an environment in empirical units, and thus he can compare probes which have slightly different dimensions.

Experience with the hydrogen probe has indicated that several days may be required for the instrument to become stable. Thereafter the rate of pressure rise is closely related to changes in processing conditions which influence hydrogen attack. The probe has proved useful in evaluating the severity of hydrogen activity before blistering or fissuring of the steel became apparent.

A Pre-Installation Test to Avoid Hydrogen Blistering

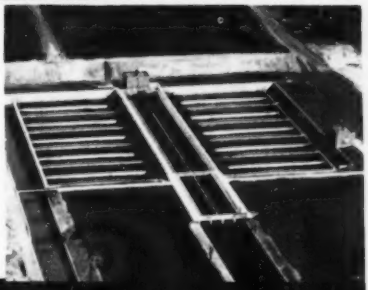
CORROSION of steel refinery equipment in the form of hydrogen blistering has now been recognized as an important problem by petroleum processing engineers.[1,2,3,4]

A pre-installation test for steel intended for service where hydrogen blistering might possibly be encountered was suggested recently by a research metallurgist with a large steel

95% OF OIL RECOVERED FROM REFINERY WASTE WATER BY HARDINGE SEPARATORS

(Above) Part of the Hardinge installation of 11 rectangular clarifiers (oil separators) which remove about 300 barrels of heavy emulsion per day from 35,000 g.p.m. of refinery waste water at two Ohio refineries.

(Right) Aerial view shows primary clarifier in center with five secondary clarifiers on each side. The waste water enters through the culvert in the center and the effluent with 95% of oil removed flows out the canal at left.



300 Barrels Per Day Recovered

With increased demands for better methods of handling refinery waste water, systems using Hardinge Clarifiers as the primary separator have been gaining in popularity because of the high recovery of oil from the waste water. In this Ohio installation, the effluent from the Hardinge system contained 80 to 85% less oil than the previous system. Our engineers will provide you with the facts that you require.

HARDINGE COMPANY, INCORPORATED

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(To obtain more data on advertised products see page 908)

4 STRATEGIC ASSEMBLY POINTS

to speed deliveries of STABILFLO VALVES

The four sources of supply and service indicated above add another Foxboro *plus value* to the advantages of these unique process control valves. Each source is equipped to assemble Stabilflo Valves in a variety of sizes and materials to meet most specific needs . . . and staffed by expert application engineers and valve specialists.

Keep the nearest source of Stabilflo Valves in the back of your mind when lining up new control valve applications or replacements. It's a Foxboro *plus value* that counts in profitable plant operation. Also get all the details on the following Stabilflo Valve features:

1. *50 to 1 rangeability with equal percentage flow characteristics*
2. *High lift V-Port: greater increment of lift for a given change in air pressure . . . and increased accuracy of positioning*
3. *Self-aligning, inverted-type motor — practically eliminates all sources of friction in motor action*
4. *High sensitivity of response*
5. *High force-friction ratio — negligible hysteresis*
6. *Vibration resistant*
7. *Rugged construction*
8. *Easily reversed action*
9. *Renewable seat rings*

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manufacturer.[5] Essentially an electrolytic test using sulfuric acid, it has now been described in greater detail for PETROLEUM PROCESSING readers by this same engineer:

". . . the particular test . . . is not a standard test or a specification used generally in the industry, but is merely an arbitrary method of determining how severe blistering might be on material intended for zinc plating.

"The electrolyte solution contains 15 to 20% by weight sulfuric acid (13.4 to 17.7° Be.) Descaled specimens are made the cathode in the electrolyte and the test is run for six hours at a current density of 10 amps. sq. ft. The temperature is maintained at 100 to 120° F. Under such conditions all specimens show some very light blistering which would be considered normal. Certain lots of material, however, are found to be subject to severe blistering and fissuring under these testing conditions and are, therefore, not considered for zinc plating applications.

"While such a test is not actually related to the refining industry, we mentioned it previously[5] since it showed that certain lots of material varied from others in susceptibility to blistering by hydrogen. This would correspond with similar observations in the recent paper[4] which showed marked differences even between two adjacent plates in the walls of some equipment. We do not feel qualified to say whether such a test would be applicable in this case, but mentioned it because it might suggest some possibilities in regard to controlling this refinery corrosion problem."

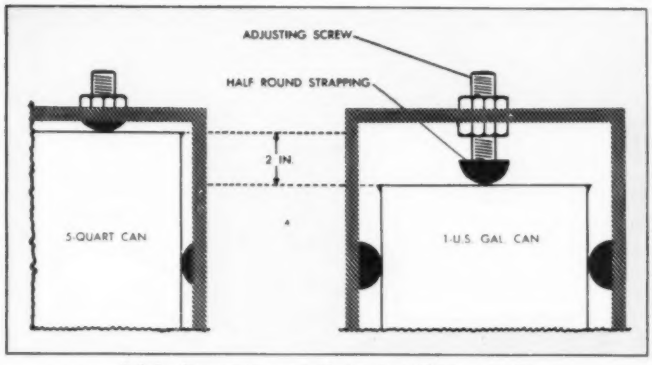
References

(1) "Stopping Refinery Corrosion," PETROLEUM PROCESSING, May, 1949, p. 540.
(2) "Hydrogen Blistering of Steel—A Source of Damage to Vessels," PETROLEUM PROCESSING, Aug., 1949, p. 898.
(3) "Corrosion Damage to Interior of Vessel Walls from Hydrogen Blistering Studied," PETROLEUM PROCESSING, March, 1950, p. 253.
(4) "Hydrogen Attack on Steel," PETROLEUM PROCESSING, May, 1951, p. 500.
(5) "Hydrogn Blistering," letter to the editor from William G. Renshaw, Allegheny-Ludlum Steel Corp., PETROLEUM PROCESSING, June, 1951, pp. 579-582.

What's Your Experience?

If any PETROLEUM PROCESSING *readers have had any experience with this type of test in fighting hydrogen blistering, your Plant Practices Editor would be pleased to learn the details so they might be passed on to others in the industry.*

Fast Size Adjustment on Can Filler



Quick changeover method for can-filling machine

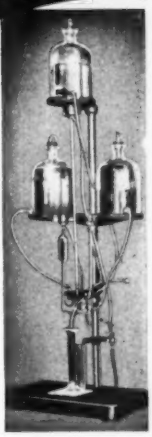
THE simple technique, shown in the accompanying sketch, for changing a can filling machine from handling 5-qt. to 1-gal. containers has provided a saving of about 96% in labor costs at Socony-Vacuum Oil Co.'s Paulsboro, N. J., refinery.

A changeover from the larger to the smaller can in filling operations occurs quite frequently in packaging procedures. Normally it has required 32 man-hours since it involves changing all can guides, twister guides, and balance beams from the cable conveyor to the filling machine. In the new and improved method illustrated, the top guide rail has been made adjustable to a height difference of 2 inches, sufficient to accommodate the two different size cans. The entire machine can be changed over in a matter of $1\frac{1}{2}$ hours, for a saving of $30\frac{1}{2}$ hrs.

The scheme was adopted as a result of a suggestion by Paulsboro employe Paul L. Jessup.

More Plant Practices, page 882

SULFUR and CARBON *Analyses* in PETROLEUM PRODUCTS



The sulfur content of oils, waxes and greases is an important measure of the value and quality of the product.

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THE application of insulation and a weatherproof finish on an outdoor storage tank in a Midwest plant illustrates the four steps in an effective technique for insulating large, cylindrical vessels.

In the picture above, a tank which is to contain liquid at 270° F., is being insulated with $1\frac{1}{2}$-in. thick, mineral wool blankets, in 24 x 48 in. sections, covered with expanded metal lath on one side, and wire netting on the other. The four steps are shown, from bottom to top:

1) Mineral wool blankets, metal lath covering on the outside, are being tightly butted together and secured to the tank by 1-in. galvanized iron bands encircling the tank on 9-in. centers.

2) A single $\frac{3}{4}$-in. layer of insulating cement is trowelled into the metal lath covering.

3) The 1-in. mesh wire netting is stretched over the dry cement.

4) A coat of asphalt mastic, $\frac{1}{8}$ in. thick when dry, is trowelled into the wire netting and smoothly surfaced to finish the operation.

The method is designed to maintain tank contents temperature under all weather conditions with a minimum of maintenance and repaid.

—*Industrial Mineral Wool Institute*

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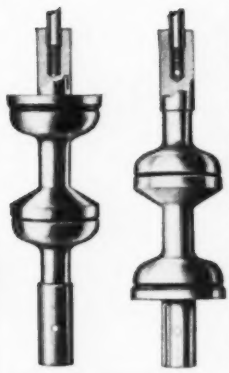

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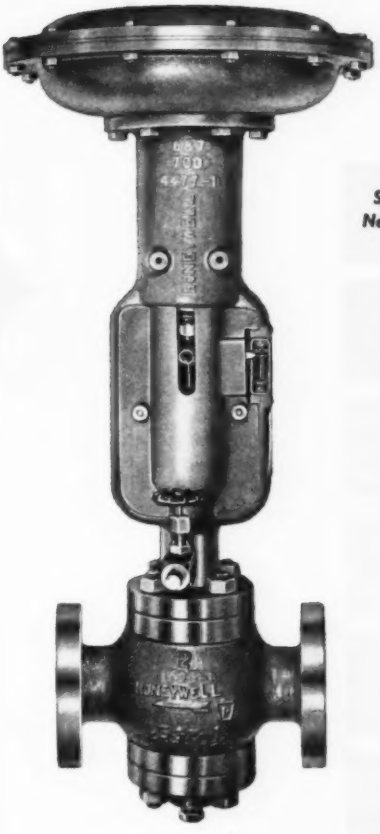
Design of plugs and bodies permits easy reversing in field. Simply invert body and plug and reattach. No extra parts or complicated adjustments required. Valve travel indicator plate is etched on both sides and need only be turned over when inner valve action is reversed.



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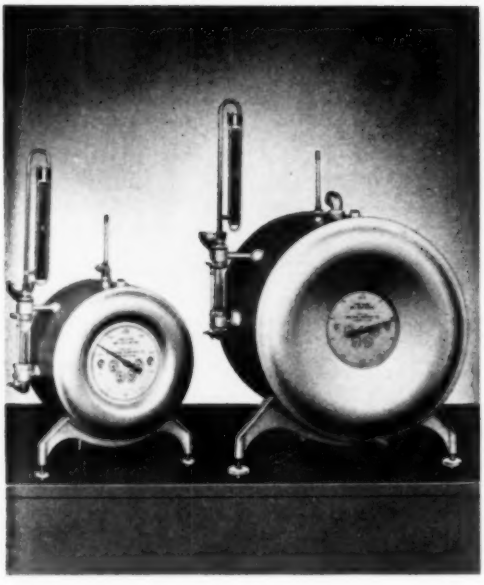

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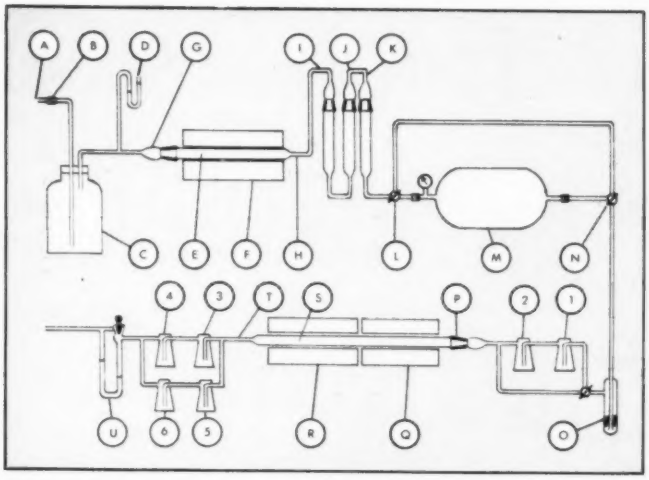

New gravimetric method for analyzing exhaust gas in jet engine tests developed and used by Bureau of Standards

Jet Engine Efficiency Test

Gravimetric method for analyzing exhaust gas

ACCURATE data on the efficiency of the combustion process in jet engines can be provided by a gravimetric method of exhaust-gas analysis developed recently by Fillmer W. Ruegg and Carl Halpern of the National Bureau of Standards.

Fuel burned in jet combustion chambers releases energy which is converted either to thrust, to shaft horsepower, or to both, depending upon the type of installation. Combustion efficiency therefore has a direct bearing on the over-all efficiency of the engine. While the combustion efficiency can be calculated from observations of the temperatures and rates of flow of air, exhaust gas, and fuel, it is often difficult or impossible to make sufficiently accurate measurements of these variables.

Common methods of gas analysis have also proved unsatisfactory for this purpose because the fuel is burned with so much excess air that the concentration of the products of combustion is very low. To provide a more effective means for studying jet combustion efficiency, NBS undertook to develop a reliable method of exhaust-gas analysis. Because analysis by weight gives precise results for small quantities, gravimetric methods were applied to this problem.

The new method aims primarily to determine the efficiency of the combustion rather than to identify all constituents. Essentially, it involves 1) the determination of the products of complete combustion—water and carbon dioxide, present initially in the sample—and 2) the determination of water and carbon dioxide obtained by oxidizing any combustibles remaining in the sample. All the water and CO_2 initially present in the partially burned exhaust gas are first removed separately by absorption on solid reagents. The combustibles remaining in the gas are then burned completely in a quartz combustion tube, and the water and CO_2 thus formed are selectively absorbed as before. From the weights of water and CO_2 collected before and after complete combustion the combustion efficiency of the jet engine can be calculated, using the following equation:

$$n_b = 1 - \frac{W_1 - 1.50\,W_2}{W_3 - 1.50\,W_4}$$

where: n_b = combustion efficiency,
W_1 = wt. of CO_2 determined by burning combustibles in exhaust.
W_2 = wt. of water obtained from the unburned material.
W_3 = sum of the wts. of CO_2 originally in the sample and that obtained from the combustibles.
W_4 = wt. of water originally in the sample plus wt. of water from the unburned material.

While W_1, W_2, and W_3 are experimental values, W_4 is calculated from the total weight of CO_2 collected in the absorption bottles. Before substitution in the equation, W_1 is corrected for the CO found to be present in the sample.

The apparatus for the NBS gravimetric method is shown schematically in the diagram. A sample of exhaust gas from the 16-liter, stainless steel sample container *M* enters the analysis section of the apparatus through the three-way stopcock *N*. It first passes through the cold trap *O*, kept at −78° C., and then through absorption bottles 1 and 2, where water and CO_2 are absorbed. Bottle 1 contains drierite and phosphorus pentoxide, separated by asbestos; bottle 2 contains ascarite and phosphorus pentoxide, separated by asbestos. Hydrocarbons, which would otherwise be adsorbed on the surface of the reagents used to absorb water and CO_2, are condensed and remain in the cold trap.

The remaining gases enter the quartz combustion tube *S* containing copper oxide at 1000° C., and surrounded by electric heaters *Q* and *R*. Here combustibles such as CO, H_2, and CH_4 are oxidized to water and CO_2 which in turn are absorbed in bottles 3, 4, 5, and 6. Bottles 3 and 5 contain anhydrone and phosphorus pentoxide, separated by asbestos; bottles 4 and 6 contain ascarite and phosphorus pentoxide, separated by asbestos.

The condensate in the cold trap *O* is then volatilized by gentle heating and flushed into combustion tube *S* by a stream of dry, CO_2-free air. This flushing air is supplied by the apparatus at the upper left, consisting of a source of compressed air (at *A*), a control valve *B*, a jar of activated alumina *C*, a mercury manometer *D*, a quartz combustion tube *E* containing copper oxide wire, an electric heater *F*, and a series of absorption tubes *I*, *J*, and *K*. After complete combustion of these fuels, the resulting water and CO_2 are collected as before. The weights of water and CO_2 collected both before and after the combustion are obtained separately. In addition, a small portion of the sample is analyzed for its CO content by use of the NBS Carbon Monoxide Indicator. Rate of gas flow is determined by the flow meter *U*.

In studies of this method at the Bureau of Standards, several samples of known composition, containing substances typical of actual exhaust gas, were prepared and analyzed. Agreement between combustion efficiency calculated from the known composition and from the analytical data was excellent. In fact, in one large series of analyses, the combustion efficiency calculated from the analytical data agreed within one per cent with that obtained from heat and flow measurements of the actual combustion chamber.

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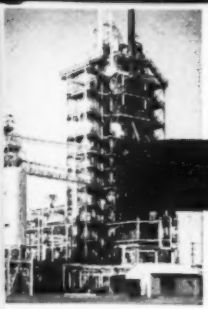

PROCESSING PATENTS

New Developments in Processes and Products

By PETER J. GAYLOR
Editor, "The Technical Survey"

Details on Reforming with Platinum Revealed in New Atlantic Patent

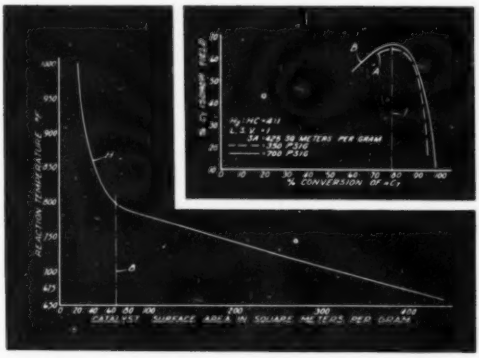

Fig. 1 — Yield-conversion relationship with platinum reforming (Atlantic Refining Co. — U.S. 2,550,531)

Fig. 2— Effect of catalyst surface area on reforming temperature required for maximum isomer yield (U.S. 2,550,-531)

RECENT shortages in the benzene supply and demand for high octane aviation fuel have initiated work toward development of a process which will produce these materials in quantity in one step. Universal Oil Products Co. already has installed a number of Platforming plants which essentially employ reforming in presence of a platinum catalyst. Atlantic Refining Co. also announced the development of a platinum catalytic reforming operation and already is installing commercial units. One of Atlantic's patents was just issued and contains considerable information on the process.

This patent (U. S. 2,550,531) discloses that the petroleum hydrocarbons which are usually reformed are mixtures of paraffinic hydrocarbons having mainly straight chain or slightly branched chain structures, as well as cyclic compounds, particularly cyclohexanes, together with varying proportions of aromatics. To obtain the best results in reforming such mixtures, it is desirable to produce maximum isomerization of the paraffins to increase branching, isomerization of alkylcyclopentanes to cyclohexanes, and dehydrogenation of the cyclohexanes to aromatics, together with selective cracking of the high molecular weight paraffins which are liquid at ordinary temperatures, and dehydrocyclization of the paraffins to aromatics. At the same time, it is desirable to keep at a minimum the demethanation of the paraffins during isomerization, or hydrogenation of aromatics to naphthenic hydrocarbons and indiscriminate or uncontrolled cracking, particularly of the paraffins.

All reactions during reforming are reversible, depending on the various equilibria involved. The reversal of the dehydrogenation reaction of the cyclo compounds to aromatics takes place most readily, while the reversal of the cracking reaction is most difficult, particularly if carbon is formed during the cracking.

The isomerization of the paraffins is one of the important factors in reforming. During isomerization, methyl and some ethyl groups are shifted from the straight chain to side chain positions, and this should be done with a minimum of demethanation and carbon production. The carbon to carbon bonds, instead of being broken, are merely put under a strain, in which condition, particularly when catalyst is present, they shift to the side chain position to produce an isomer in which the carbon atoms are more centralized, as compared to a straight chain compound.

Still another important series of reactions is the isomerization of alkyl cyclopentanes to cyclohexanes followed by dehydrogenation of the latter, together with those originally present in the mixture, to aromatics. An additional means of forming aromatics is the dehydrocyclization of acyclic paraffins. These reactions result in an increase in the anti-knock characteristics of the reformed products since the octane rating of aromatics is very high compared to that of the saturated cyclo compounds.

Selective cracking of the long chain paraffins into low boiling fractions, particularly when the charging stock contains components boiling above about 400 F., is also important both because such lower boiling fractions, by virtue of their lower molecular weights, have higher octane numbers and because such lower boiling components may be further increased in anti-knock value by the above described reactions.

The isomerization, however, should be accomplished with a minimum of demethanation and carbon deposition both because demethanation reduces yields, and carbon deposition affects catalytic activity, further reducing yield. The presence of hydrogen during the reforming decreases the demethanation reaction and, when a carbon to carbon bond is broken (as when the higher molecular weight paraffins are cracked, or when a methyl or ethyl group is broken off the paraffin) the hydrogen saturates the carbon and, in the case of the ethyl or methyl groups, forms the corresponding gas and thereby greatly reduces carbon deposition.

In the Atlantic patent, the discovery is reported that a silica-alumina catalyst, having a particular surface area, and impregnated with platinum or palladium, displays a maximum isomer yield from open chain paraffins during the catalytic reforming of these compounds with such a catalyst.

It was also discovered that the maximum isomer yield obtainable with such catalysts having certain surface areas is extremely sensitive to temperature, when the surface area of the component, upon which the platinum or palladium is deposited, is greater than about 65 sq. meters per gram of component. With surface areas smaller than this value, the catalyst is substantially insensitive to temperature in so far as obtaining maximum isomer yield is concerned. The change in sensitivity to temperature is claimed to be so great at a surface area of about 65 sq. meters per gram of component, as

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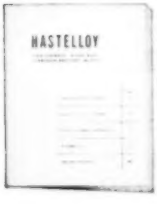
For complete information, write for the 40-page booklet, "HASTELLOY High-Strength, Nickel-Base, Corrosion-Resistant Alloys." It contains data on the properties, available forms, and fabricating techniques for all three grades of HASTELLOY alloy.

This condenser, made of HASTELLOY alloy B, shows no signs of corrosion after two and one-half years in a vacuum still for the distillation of hydrochloric acid. Since it was installed, the unit has been in operation two to three days a week, eight hours a day, handling a dilute solution of the corrosive acid at temperatures up to the boiling point.

HASTELLOY alloy B is one of the few commercially available materials that can handle boiling hydrochloric acid—one of the most severely corrosive agents known to the chemical industry. Alloy B is available in all standard wrought forms and can be fabricated by most common methods. Two additional HASTELLOY alloys, designated as C and D, are also available for handling other highly corrosive chemicals, such as sulphuric acid and certain strong oxidizing agents, like ferric chloride and wet chlorine.

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to be of critical importance in the reforming of hydrocarbons.

By controlling the surface area of the catalyst, high isomer yields at high temperatures can be accomplished during reforming, regardless of pressure, since isomerization is independent of pressure, which permits use of high reaction temperatures favoring maximum production of aromatics. Also, because of this, higher hydrogen partial pressures at higher pressure may be used to reduce the amount of demethanation and carbon deposition, thus further contributing to the high yield of high octane products and increased life of the catalyst without regeneration.

At surface areas of 10 sq. meters per gram of silica-alumina component and below, the activity of the catalyst drops off rapidly, so that surface areas of from 10-65 sq. meters per gram of component should be used. This component mixture is impregnated with platinum or palladium in amount of 0.01-2.5% by weight of the final catalyst. Reforming of the gasoline fraction with such catalyst is carried out at 600-1000° F., at 100-1000 psi. and at an hourly liquid space velocity of 0.1-10, in presence of 1-20 mols of hydrogen per mol of hydrocarbon.

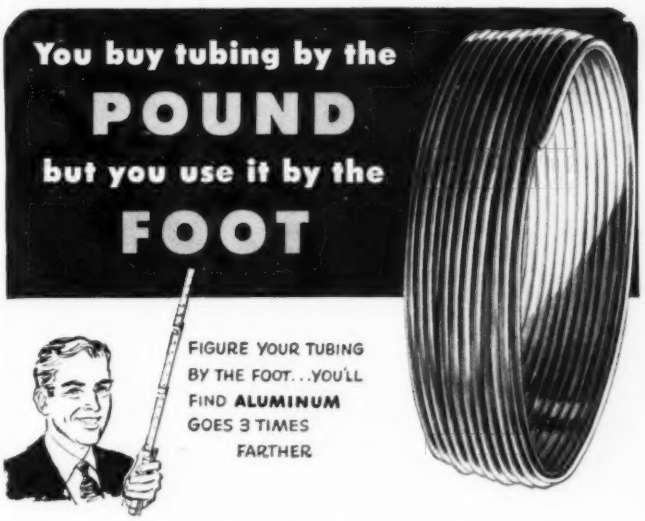
An important feature of the invention is the low surface area component upon which the platinum is deposited, which has some activity to catalyze cracking, but at a low rate compared with the high surface area catalyst used in cracking. This component may be a natural aluminum silicate or activated clay, such as Super Filtrol. The catalyst may contain 20-95% by weight of silica with the remainder alumina, and may be in the form of beads or granules. The surface area is adjusted before depositing the platinum by steaming the silicate at 900-1400° F. for 50-100 hrs.

The platinum may be applied in the form of an aqueous solution of chloropalladic acid, and the mixture is dried and treated with hydrogen to reduce the chloride to the metal and to activate the catalyst. Spent catalyst may be reactivated by burning off the carbonaceous deposits at 900-950° F., starting with a gas containing about 2% oxygen and gradually increasing the oxygen so that pure air is passed over the catalyst at the end of the regeneration period. However, it is important that the regeneration temperature should not exceed 1000° F, since it would impair catalytic activity.

With this process, it is possible to obtain from petroleum distillates, particularly gasoline fractions, yields of 88-90% or higher, having Motor Method clear octane numbers of 71-74 or higher.

Fig. 1 is a plot of yield of isomerized C_5 hydrocarbons vs. conversion of the normal C_5 fraction. In this connection, the patent points out that each catalyst of a particular surface area (in this case one with an area of 425 sq. meters per gram being the example) exhibits a maximum yield of isomerized hydrocarbon with respect to conversion of the normal C_5 fraction. In Fig. 2, curve H is a plot of reaction temepratures for isomer yield maxima of the family of curves of which curves A and B of Fig. 2 are representative, vs. the surface area of the corresponding catalysts. It will be noted that the right hand portion of the curve is flat and has a very low slope while the left hand portion is extremely steep, and that the rate of change of slope of the curve increases rapidly at about a value of 65 sq. meters per gram.

Results are given to indicate flexibility of the catalyst in reforming hydrocarbons by virtue of its reduced sensitivity to temperature at low surface areas of the cracking component.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(To obtain more data on advertised products see page 908)

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SAVED 10% IN STEAM COSTS

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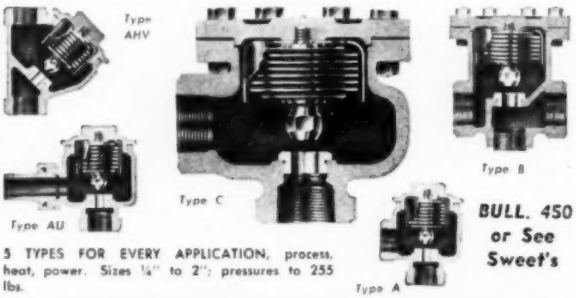

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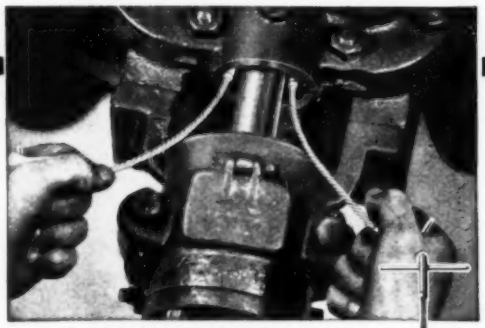

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DURAMETALLIC CORPORATION

KALAMAZOO MICHIGAN

(To obtain more data on advertised products see page 908)

and to show that the catalyst permits reforming of hydrocarbons to obtain high yields of a reformed product of high anti-knock characteristics.

The broad claim of the patent covers a process for reforming a petroleum distillate fraction boiling within the gasoline-kerosine range to increase the anti-knock value thereof, comprising subjecting the fraction to contact, at reforming conditions, in the presence of hydrogen with a catalyst comprising a cracking component and a metal from the group consisting of platinum and palladium, said cracking component comprising silica and alumina and having a surface area in the range of about 10-65 square meters per gram of said component.

Incidentally, there has been considerable work done in the past, particularly by Russian workers, on the reforming of pure hydrocarbons with platinum and palladium catalysts, and it is surprising that none of these articles was cited by the Patent Office against the application.

Benzenoid Compounds Used In Sweetening Distillates

A PATENT issued to Standard Oil Development Co. (U. S. 2,552,399) discloses a method of sweetening sour petroleum distillates having end points not higher than 750° F. and containing mercaptans, by adding to the distillate a small amount of benzenoid compound such as amine or phenol, and then contacting the distillate blend with a catalytic amount, no more than 5% by volume, of an alkali metal hydroxide solution, while adding a sufficient amount of mild oxidizing agent to convert the mercaptans to disulfides. Among the benzenoid compounds suggested are hydroquinone, pyrogallol, paraphenylene-diamine and so forth. The alkaline solution is preferably of 30-50° Baume and the preferred temperature range is 70-95° F. It is apparently desirable to remove hydrogen sulfide. Oxygen is used as the oxidizing agent. Results show reduction in copper numbers from 40 to 8-10.

Xylenols Aid Desulfurization Of Heavy Fuel Oils

BECAUSE mercaptans present in heating oil boil within the range of the oil and thus are of high molecular weight, they are not as readily extracted with caustic-methanol solutions as are lower boiling mercaptans. In U. S. 2,549,052 Universal Oil Products Co. proposes to improve the extraction of such mercaptans by contacting the oil with an alkali-solvent solution containing heavy xylenols. The heavy hydrocarbon oil is contacted with a reagent solution con-

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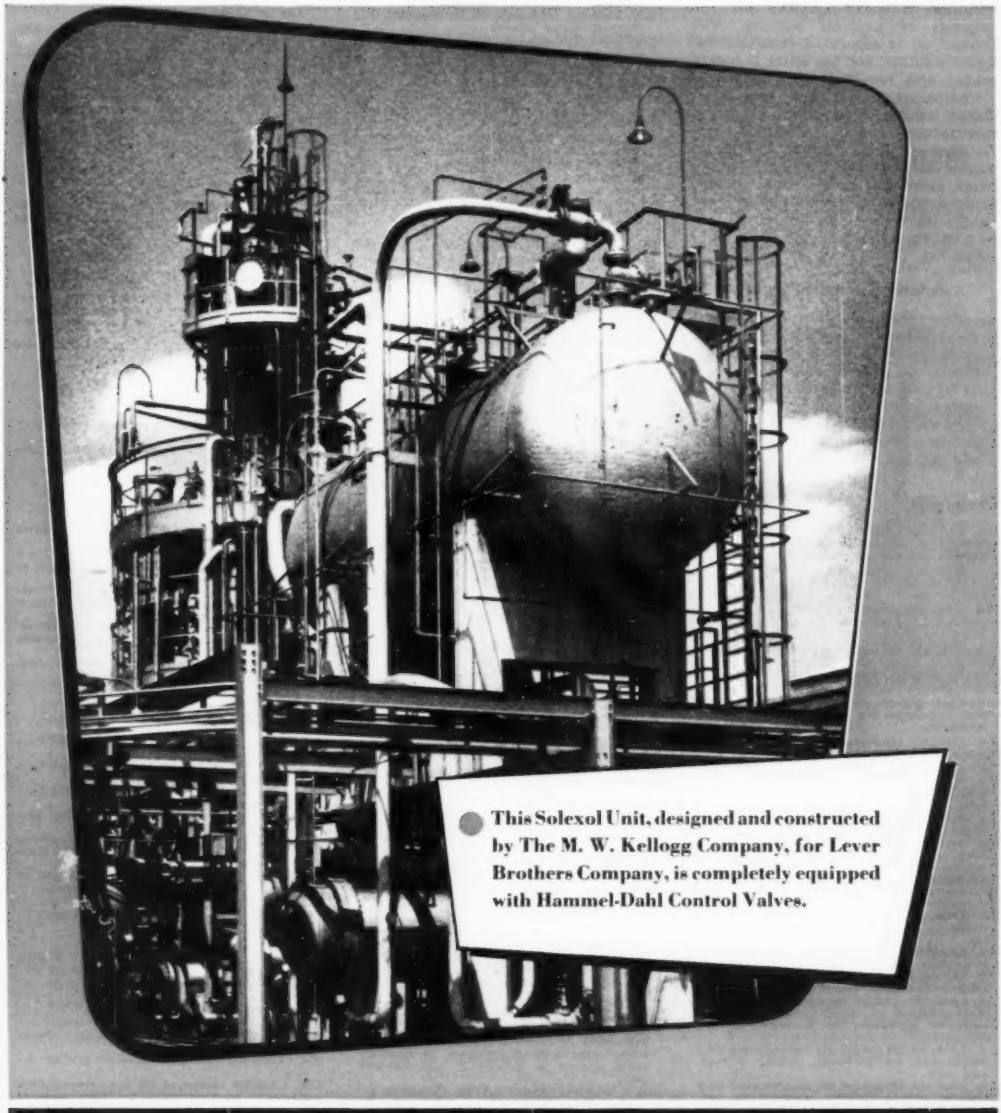

This Solexol Unit, designed and constructed by The M. W. Kellogg Company, for Lever Brothers Company, is completely equipped with Hammel-Dahl Control Valves.

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taining an aqueous solution of caustic of 35-50° Baume, about 29-40 volumes of methanol per 100 volumes of aqueous solution, and about 2-20 volumes of heavy xylenols per 100 volumes of aqueous solution. The treated oil is separated from the reagent solution, and the latter is regenerated and recycled.

Comparative tests on a sour West Texas heating oil containing 0.08% mercaptan sulfur and 0.81% total sulfur showed a reduction in mercaptan sulfur to 0.0175% with a 5-stage batch extraction using caustic-methanol, to 0.0077% when phenols are used with the caustic-methanol, and to 0.0018% when heavy xylenols are employed.

Patents Issued in June

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for June 5, 12, 19 and 26, Vol. 647, Nos 1-4.

Chemicals

U.S. 2,555,509 (Universal Oil Products Co.) Stabilizing organic compounds with hydrocarbon dinitroso compound.

U.S. 2,555,518 (Universal Oil Products Co.) Photochemical preparation of polyphenylalkanes.

U.S. 2,555,553 (Stanolind Oil & Gas Co.) Separation of aldehydes and ketones from mixtures.

U.S. 2,555,595 (Shell Development Co.) Esters of unsaturated acid-branched chain hexadiene polymer adducts.

U.S. 2,555,665 (Phillips Petroleum Co.) Monoether of ethylene glycol for activating emulsion polymerization in presence of heavy mercaptan.

U.S. 2,555,721 (California Research Corp.) Removing free phenol from tetra-aryl orthosilicate.

U.S. 2,555,927 (Phillips Petroleum Co.) Hydroxylation of unsaturated compounds with hydrogen peroxide.

U.S. 2,555,939 (Phillips Petroleum Co.) Distillation of styrene from polymers.

U.S. 2,556,158 (Universal Oil Products Co.) Wax-like condensation product of ethylene and rubber.

U.S. 2,556,177-8 (Great Lakes Carbon Co.) Carbon disulfide by reacting heavy hydrocarbonaceous material with sulfur.

U.S. 2,556,248 (Standard Oil Development Co.) Ether purification by distillation and adsorption.

U.S. 2,556,256 (Standard Oil Development Co.) Fractional separation of sulfonic acids.

U.S. 2,556,430 (Pure Oil Co.) Preparing mixed sulfur-hydrocarbon vapors.

U.S. 2,556,799 (Phillips Petroleum Co.) Heteropolymerization of sulfur dioxide and unsaturated compound in presence of iron phosphate.

U.S. 2,556,848 (Standard Oil Development Co.) Phosphorus sulfide-treated phenol sulfonic acid salts.

U.S. 2,556,851 (Standard Oil Development Co.) Use of recycle aqueous acrylonitrile condensate in butadiene emulsion polymerization.

U.S. 2,556,856 (Standard Oil Development Co.) Reacting alkyl mercaptans with synthetic rubbery diolefin polymers.

U.S. 2,556,857 (Standard Oil Development Co.) Low temperature polymerization.

U.S. 2,556,859 (Standard Oil Development Co.) Further activating activated carbon.

U.S. 2,556,880 (Solar Mfg. Co.) Synthetic oils and resins by condensing chlorinated derivatives of toluene.

U.S. 2,557,094 (Standard Oil Development Co.) Isobutylene-p-chloro-styrene-styrene tripolymer.

U.S. 2,557,281-2 (du Pont de Nemours & Co.) Oxidation of petroleum cyclohexane to adipic acid.

U.S. 2,557,363 (Standard Oil Development Co.) Amine activated polymerization process.

U.S. 2,557,639 (Shell Development Co.) Esterification with allyl type alcohols.

U.S. 2,557,641 (Standard Oil Development Co.) Polymer curing process.

U.S. 2,557,642 (Standard Oil Development Co.) Synthetic rubber compound.

U.S. 2,557,643 (Shell Development Co.) Conversion of hydro-sulfides to neutral sulfur compounds.

U.S. 2,557,664-6 (The Texas Co.) Thiophene from hydrocarbon and SO_2.

U.S. 2,557,673 (The Texas Co.) 3-Substituted derivatives of 2,3-dihydrothianaphthene-1-dioxide.

U.S. 2,557,678 (The Texas Co.) Thiophene from hydrocarbons, alcohols, or monohalo hydrocarbons, with SO_2.

U.S. 2,557,684 (Standard Oil Development Co.) Inhibiting polymerization of diolefins.

U.S. 2,557,701 (Standard Oil Development Co.) Catalytic reaction of olefins with carbon monoxide and hydrogen.

U.S. 2,557,708 (The Texas Co.) 3-Iodothianaphthene and picrate.

U.S. 2,557,910 (Standard Oil Development Co.) Chemical reactor and recovery unit.

U.S. 2,557,924 (Universal Oil Products Co.) Esters of hydrazoic acid.

U.S. 2,557,935 (Universal Oil Products Co.) Resinous reaction product of an aromatic polyketone and a polysulfuramide.

U.S. 2,558,221 (Phillips Petroleum Co.) Oxidizing t-alkyl mercaptan to di-t-alkyl sulfide with oxygen in presence of bauxite.

U.S. 2,558,494 (Shell Development Co.) Polymerizing fatty oils with antimony trichloride.

U.S. 2,558,498 (Shell Development Co.) Decalin-hydroperoxide catalyzed reaction between sulfurdioxide and rubbery polymers of diolefine.

U.S. 2,558,507-8 (Shell Development Co.) Thiophene compounds from mono-olefins and hydrogen with alumina catalyst.

U.S. 2,558,527 (Shell Development Co.) Rubbery polymer-acid reaction products.

Refining

U.S. 2,555,650 (Union Oil Co. of Calif.) Azeotropic distillation of heptane from methylcyclohexane.

U.S. 2,555,940 (Phillips Petroleum Co.) Removing diolefin impurity from olefin.

U.S. 2,556,157 (Universal Oil Products Co.) Methanol-caustic removal of mercaptans from oils.

U.S. 2,556,269 (Standard Oil Development Co.) Conversion of salts in petroleum oils.

U.S. 2,556,275 (Standard Oil Development Co.) Treating synthetic naphtha to remove oxygenated compounds.

U.S. 2,556,387 (Pure Oil Co.) Inhibiting corrosion of ferrous equipment in caustic regeneration with nitrate.

U.S. 2,556,414 (Standard Oil Co.—Indiana) Separating mercaptans from caustic-methanol.

U.S. 2,557,084 (Petrolite Corp.) Breaking petroleum emulsions.

U.S. 2,557,257 (Shell Development Co.) Extractive fractionation using urea.

U.S. 2,557,406 (Ashland Oil and Refg. Co.) Solvent extraction and dewaxing of mineral oils.

U.S. 2,557,682 (Standard Oil & Development Co.) Condensing vapor streams.

U.S. 2,557,923 (Phillips Petroleum Co.) Separating olefins from mixtures with cuprous salt in methoxyethylamine.

U.S. 2,557,940 (Phillips Petroleum Co.) HF refining of lube oils.

U.S. 2,558,137 (Phillips Petroleum Co.) Desulfurizing by allowing olefins to react with sulfur compounds in presence of alumina-silica catalyst at 150-550° F. and 500-2000 psig.

U.S. 2,558,510-3 (Petrolite Corp.) Breaking petroleum emulsions.

U.S. 2,558,587 (Phillips Petroleum Co.) Foam prevention in extractive distillation of hydrocarbons.

Conversions

U.S. 2,556,114 (Sinclair Refining Co.) Pyrolytic conversion with aid of catalyst.

U.S. 2,556,198 (Houdry Process Corp.) Catalytic conversion with moving catalyst.

U.S. 2,556,280 (Standard Oil Development Co.) Catalytic reforming with promoting zinc aluminate spinel.

U.S. 2,556,301 (Standard Oil Development Co.) Contacting solid particles and gaseous fluids.

U.S. 2,556,514 (Socony-Vacuum Oil Co.) Hydrocarbon conversion with moving catalyst.

U.S. 2,557,113 (Sun Oil Co.) Catalytic reaction of isoparaffin hydrocarbons.

U.S. 2,557,115-6 (Sun Oil Co.) 2,2,4-Trimethyl pentane by alkylation.

U.S. 2,557,117 (Sun Oil Co.) Self-alkylation of isopentane.

U.S. 2,557,118 (Sun Oil Co.) Alkylation of isobutane with propylene.

U.S. 2,557,680 (Standard Oil Development Co.) Fluidized process for carbonization of carbonaceous solids.

U.S. 2,557,748 (Shell Development Co.) Hydrocarbon conversion.

U.S. 2,558,194 (Universal Oil Products Co.) Fluid catalytic conversion of different hydrocarbon feeds.

U.S. 2,558-375 (Sinclair Refining Co.) Catalytic conversion followed by aluminum halide treatment.

Specialties

U.S. 2,556,173 (Ebel) Cleaning fluid for desludging internal-combustion engines.

U.S. 2,556,300 (Standard Oil Development Co.) Insecticidal composition.

U.S. 2,558,030 (Zisman et al.) Non-flammable hydraulic fluid.

Lubricants

U.S. 2,556,289 (Standard Oil Development Co.) Wire rope lubricant (lithium base).

U.S. 2,558,079 (The Texas Co.) Mineral lube oil containing chlorinated hydrocarbons.

Fuels

U.S. 2,556,833 (Ethyl Corp.) Ethyl chloride recovery.

U.S. 2,557,019 (Standard Oil Development Co.) Leaded fuel containing sulfur compound as scavenging agent (alkyl thiophenes).

U.S. 2,557,171 (J. F. Pritchard & Co.) Treating natural gas effluent to produce higher Btu value product.

U.S. 2,557,549 (Gasoline Research Industrial & Commercial Co., Inc.) Solids containing liquid hydrocarbons.

U.S. 2,558-207 (Ethyl Corp.) Alkyllead compounds.

Hydrocarbon Synthesis

U.S. 2,556,835 (Standard Oil Development Co.) Synthesis gas mixtures.

U.S. 2,556,850 (Standard Oil Development Co.) Separating oxygen from air.

U.S. 2,556,861 (Standard Oil Development Co.) Hydrocarbon synthesis plant.

U.S. 2,557,842 (Ruthruff) Hydrocarbon synthesis with fluidized catalyst.

U.S. 2,558,556 (The Texas Co.) Hydrocarbons and oxygenated compounds from carbon monoxide and hydrogen.

U.S. 2,558,557 (The Texas Co.) Extraction of alcohols from the F-T synthesis product.

Catalysts

U.S. 2,558,206 (Phillips Petroleum Co.) Drying hydrogel.

Miscellaneous

U.S. 2,555,640 (Phillips Petroleum Co.) Packing gland lubricator.

U.S. 2,556,696 (Kufner) Gasoline mixing device.

U.S. 2,556,854 (Standard Oil Development Co.) Magnetic coupling drive for high pressure stirred reactors.

U.S. 2,557,018 (Standard Oil Development Co.) Suppression of carbon formation and carburization in gas turbine and jet propulsion engines.

U.S. 2,557,020 (Standard Oil Development Co.) Sulfur in the suppression of carburizing in gas turbines and jet propulsion engines.

U.S. 2,557,650-1 (Standard Oil Development Co.) Reducing oxidic ores.

U.S. 2,558,356 (Danciger Oil & Refining Co.) Pressure control device.

U.S. 2,558,359 (Phillips Petroleum Co.) Burner system for weed burners.

U.S. 2,558,363 (Ethyl Corp.) Photocatalytic manufacture of benzene hexachloride.

DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

August ★ *One of a Series of Interest to the Petroleum Industry* ★ *1951*

Brakes Relined with a 'BANG'

New Du Pont explosive rivets save time and money in relining brakes. This saving is especially important to operators of heavy-duty trucks that give brakes real punishment.

Formerly, relining necessitated removing the brake shoes, riveting on new linings, and reinstalling them. Now, in most cases, the job can be done with Du Pont explosive rivets without removing the brake shoes from their anchor plates. The saving is about 50 per cent of the former over-all cost of replacing linings.

And explosive rivets outperform conventional rivets set by hand, as proved by dynamometer tests. Also, road tests show that linings fastened the new way are free from objectionable "brake squeal." It means more time on the road and less time in the shop for equipment regularly hauling loads on a 'round-the-clock schedule.

Du Pont 'Alamask' Odorants for the Petroleum Industry

The ability to smell is one of the five senses on which we depend for knowledge of our environment. Because a vast number of things are slightly volatile, they betray their presence and character by odor in the air we breathe. This is particularly true with many products derived from petroleum.

Recently the Du Pont Company, working with petroleum technologists, developed a line of "Alamask" odorants which are finding application by the petroleum industry. These odorants are generally designed to impart a clean odor without resorting to floral, sweet, or fruity perfuming. They serve well in covering the intense odors of some grades of mineral spirits, or the sulfurous odors which may be present in various types of cutting oils. Some grades of spray oils and heater oils, which have objectionable odors are improved by the addition of the proper "Alamask" odorant.

The Du Pont "Alamask" odorants for petroleum products are oil soluble. They possess high odor coverage values. As little as one pound of a selected "Alamask" was reported valuable in reodorizing nine thousand gallons of #2 type fuel oil. In another instance, one pound of "Alamask" gave a neutral odor to seventeen thousand gallons of selected thinner.

Du Pont Gives Representatives Thorough Training to Assist Refiners

TAILOR-MADE PROGRAM COVERS MANY MONTHS

How can a Du Pont Field Representative be most helpful to refiners and marketers of petroleum products? That question led to the development of an intensive training program in the Petroleum Chemicals Division.

Trainees receive much valuable instruction in lecture rooms as a supplement to practical experience gained in TEL manufacturing areas, in laboratories and in the field.

As a result, when a Du Pont representative calls at your refinery or marketing office, he is prepared to help you solve many problems concerning TEL and other petroleum additives. His services also include merchandising aids intended to supplement your own marketing program.

To prepare prospective representatives for this important work, each goes through a specialized training program, lasting from 6 months to a year. Each prospect is carefully selected for the job. Almost all hold engineering degrees. Many have had years of actual refinery experience. The training program is adjusted to meet the individual requirements of each man.

First of all, the new prospect goes to work in the main office at Wilmington. As he progresses he studies technical literature . . . familiarizing himself with all phases of the development, manufacturing, safe handling, distribution and application of tetraethyl lead compounds and other additives.

To thoroughly learn the TEL manufacturing process, the trainee spends considerable time in the manufacturing area. Step by step, he studies each phase of manufacturing. He works on quality-control problems, practices safe handling, helps at the furnaces, studies the ethylation process. He even becomes familiar with shipping details.

At-the-plant work in the manufacture of dyes, grease stabilizers and antioxidants is also part of his program. He gets a thorough background on raw materials, processes, and equipment used.

Safety is stressed throughout the training period. Each man becomes qualified to supervise tank entries and tank car unloadings. He also masters the safe technique for handling TEL in drums. So thorough is a Du Pont representative's safety background that he is able to render valuable service to refiners in helping to train their own blending personnel.

To gain a well-rounded working

"Alamask" odorants are designed by Du Pont's Fine Chemicals Division to give better sales appeal to petroleum products at low cost. The odor of a petroleum product, when pleasant, may prove of considerable sales value.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED

Thorough Training

knowledge of the Du Pont research activities helpful to refiners, each trainee participates in the work under way at the Petroleum Laboratory. The trainee is also given a brief indoctrination course in refinery processes.

Working with the sales promotion department, the trainee learns how to best apply his knowledge to the varied problems of individual refiners and marketers. How to demonstrate fuel performance with a test car . . . how to make dealer meetings successful . . . these are but a few of the services he learns to perform. Two weeks spent in the New York Office familiarize him with district office operation.

Direct knowledge of the customer's own operations is important, too. Traveling with an experienced representative, the trainee has the opportunity to meet refinery personnel and discuss their work with them.

Through this program, Du Pont is constantly increasing the manpower behind its services . . . making it more valuable to refiners and marketers.

Supervisor of Operations also Directs Instruction of Trainees

In addition to being supervisor of operations for the Petroleum Chemicals Division, B. Gardner Crane directs the trainee instruction program. Gardner Crane came with Du Pont in 1946 after thirteen years with the Ethyl Corporation. With Ethyl's Chicago Division he acted as sales promotion engineer and chief safety engineer. In New York he was in charge of engineering in the safety department. Previous to this, from 1930 to 1933, he was engaged in sales and engineering work for the Acoustical Engineering Corporation in Milwaukee, Wisconsin.

LITERATURE AVAILABLE

The Petroleum Chemicals Division of Du Pont has published a wide variety of material of interest to the petroleum industry. This includes technical papers, bulletins, reports and memoranda as well as equipment operation bulletins, safety regulations, tank cleaning data, marketing aids and the like.

Any of this is available on request to your nearest Du Pont Petroleum Chemicals Division District Office. A partial listing of available material is shown below:

Possible Mechanisms By Which Combustion Chamber Deposits Accumulate And Influence Knock
Serial A-2087a

Tank Talk—A new 52-page booklet designed for easy reading by tank cleaning personnel Serial A-1134

Blending calculator for Du Pont TEL Compound (Aviation Mix)
Serial A-1210

Exhaust Valve Rotation—A resume covering the use of mechanical devices to improve valve life
Serial A-656

The Effect of Hydrocarbon Structure on the Road Antiknock Performance of Motor Fuels Serial A-505

Working with the Petroleum Industry—information about Du Pont's TEL manufacturing and research facilities Serial A-8620

Antiknock Antagonists—by H. K. Livingston, Jackson Laboratory.

New Data on Engine Deposits Presented by Du Pont Engineer

"Possible Mechanisms By Which Combustion Chamber Deposits Accumulate And Influence Knock" is the title of a paper presented at the SAE Summer Meeting at French Lick, Indiana by L. F. Dumont of the Du Pont Petroleum Laboratory.

It is thought that the new data presented by Mr. Dumont on knocking tendency caused by the volume, catalytic and thermal insulating effects of deposits will be of particular interest to refiners.

This figure appears in the paper, "Possible Mechanisms By Which Combustion Chamber Deposits Accumulate And Influence Knock." In the paper it is reproduced as a cross-section, 50 times enlarged, of piston top deposit showing a new technique for examination and evaluation of the effect of combustion chamber deposits on knocking characteristics.

In this connection, on the basis of the research reported in the paper, the increase in compression ratio caused by deposit volume accounts for approximately 20 to 40 per cent of engine octane requirement increase, depending on the engine type and type of deposits. It was also indicated that catalysis may not be a contributing factor, especially for leaded fuel deposits, although considerably more work will be required to confirm these results. The thermal insulating effect of deposits appears to be one of the major causes of deposit knocking harm.

Copies of the paper are available through your nearest Du Pont Petroleum Chemicals Division District Office.

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A-2231

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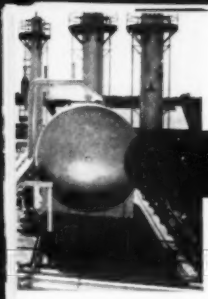


Automatic Pressure Control

Instrument utilizes constant area flow nozzle idea with variable length as its design basis

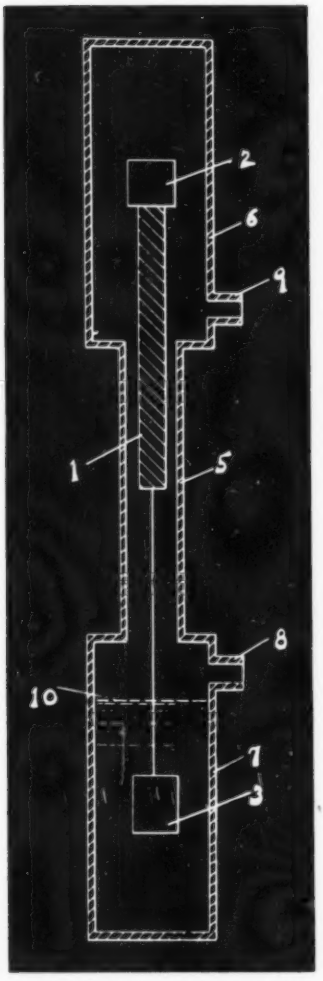


Fig. 1—Simple unit for automatic control of pressure (U. S. 2,558,356)

A RELATIVELY simple and economical pressure controller has been devised which operates on the principle of an orifice of constant cross-sectional area and of variable length, the latter which controls the flow rate of the fluid and ultimately its pressure. It is said to be applicable to the operation of a tower or reaction vessel.

The instrument is shown schematically in Fig. 1. The fluid on which pressure is to be controlled enters at 8, flows upwardly through the annular channel between rod 1 and casing 5, and leaves via line 9. Operation is as follows:

Weights 2 and 3 serve to adjust the effective weight of the vertically movable rod 1, and also to limit or dampen longitudinal pulsations, thus increasing accuracy of response. Control is obtained by reason of the dynamic pressure drop between inlet 8 and outlet 9 which results from fluid flow through the annular space. This pressure drop is constant and is equal to the net weight of rod 1 and associated weights 2 and 3 divided by the cross-sectional area of the rod.

When fluid flow through the unit is constant in rate, rod 1 remains in a stable suspended position, and therefore fluid is discharged at 9 at a given constant pressure. An increase in pressure of the entering fluid will cause a proportional rise in position of the rod and a shortening of the length of the annular channel between rod 1 and casing 5. This permits the fluid to flow through the unit at a greater rate. With proper design, the unit therefore exactly counteracts the tendency for the pressure to increase. Conversely, rod 1 will descend to counteract a tendency for the fluid pressure to decrease.

The range of the instrument may be varied by a number of factors, such as: length and diameter of rod 1 and tube 5, weight of rod 1 and weights 2 and 3, surface characteristics of the rod, and properties of the fluid flowing through the unit.

The efficiency of a device of this type has been established by constructing a control unit. A solid steel rod 1, 12 in. long and 0.25 in. in diameter was treated to establish a number of depressions 0.002 in. deep and 0.125 in. wide, uniformly distributed over the entire length of the rod at the rate of four per inch. This rod was inserted in a steel tube 5, 12 in. long and 0.3 in. I.D. Chambers 6 and 7 consisted of two 13-in. lengths of standard 0.5-in. pipe. Lower chamber 7 was filled with limpid oil to the level 10, just below inlet port 8. Weight 3 thus was completely submerged in the pool of oil.

The assembled unit was connected in a system through which natural gas was flowing, inlet 8 connected to the supply source and outlet 9 to a tower maintained at atmospheric pressure. Flow rate of the gas was varied within a range of 40 to 130 cu. ft. hr. Regardless of the flow rate, the system's discharge pressure was maintained automatically at 15 psig. This was in precise agreement with the calculated pressure expected. The weight of rod 1 and associated weights 2 and 3 was 0.736 lb. Diameter of the rod, 0.25 in., gives a cross-sectional area of 0.0491 sq. in. Rod weight divided by rod area, 0.736/0.0491, gives pressure of 15 psig. Other tests showed comparable results.

U. S. 2,558,356, issued June 26, 1951, to David H. Greene, assignor to Danciger Oil & Refining Co., Fort Worth, Texas.

Patents Issued in June

The following classified listing covers patents issued during the month of June believed to be of interest or value to petroleum processing and handling operations:

Processing, general

2,555,607 (Selas Corp. of America)—Phase separation of immiscible liquids by a porous membrane rather than centrifuging.
2,555,724 (Allis-Chalmers Mfg. Co.)—Multiple leaf type filter.
2,556,014 (Jeffrey Mfg. Co.)—Water treating apparatus.
2,556,196 (Phillips Petroleum Co.)—Apparatus and process for producing carbon black.
2,556,424 (Eastman Kodak Co.)—Apparatus for producing acetylene from light hydrocarbons.
2,556,430 (Pure Oil Co.)—Apparatus and method for preparing mixed sulfur-hydrocarbon vapors.
2,556,438 (Standard Oil Co., Indiana)—Mercaptan extraction system.
2,556,854 (Standard Oil Development Co.)—Magnetic coupling drive for high-pressure stirred reactors.
2,556,861 (Standard Oil Development Co.)—Hydrocarbon synthesis plant.
2,557,549 (Gasoline Research Industrial &

WOLVERINE COPPER TUBING *first* ON D.O.

but we're not forgetting YOU

Copper and copper base alloy tubing is specified on many Defense Orders. Wolverine tubing is often selected because it is, as you know, quality-controlled from ore to finished product and, therefore, conforms to the high standards that must be met.

Incidentally, Wolverine has been manufacturing copper and copper base alloy tubing for well over thirty years—for domestic production and in answer to government needs when required.

But like all other manufacturers, we are cognizant of the division of our obligations. Your needs, too, are recognized. Not all the copper tube we produce daily is earmarked for emergency use. The maximum percentage allowed by government regulations is being produced to take care of essential domestic needs—your other needs.

Whatever tube you can get, utilize it to the best advantage. Employ it judiciously and we shall all get along very well until the emergency is over.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Company
INCORPORATED
Manufacturers of seamless, non-ferrous tubing
1425 CENTRAL AVE. • DETROIT 9, MICH.

Wolverine condenser tubes stocked by
Butler Industries, Inc., 355 So. Fourth St., Beaumont, Texas • Phone Beaumont 5-2351

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA
Sales Offices in Principal Cities

Commercial Co., Inc., Panama)—Apparatus for the preparation of solids containing liquid hydrocarbons.
2,557,910 (Standard Oil Development Co.)—Chemical reactor and recovery unit.

Furnaces and Boilers

2,555,322 (Foster Wheeler Corp.)—Tubular heater for hydrocarbon and like fluids.
2,555,552 (Petro-Chem Process Co., Inc.)—Header box design for upper header box of vertical furnaces or boilers.
2,556,801 (James K. Lukas)—Automatic water feeding device for maintaining proper level in a steam boiler.
2,557,282 (Centrifix Corp.)—Line purifier for steam systems.
2,557,569 (Stone & Webster Engrg. Corp.)—Furnace for the pyrolitic treatment of hydrocarbons to produce olefins.
2,557,788 (William L. Kisling) — Steam separator.

Pumps and Compressors

2,555,479 (Nathan Mfg. Co.)—Variable discharge pump and control.
2,555,610 (Phillips Petroleum Co.)—Lubricator for packing glands of centrifugal pumps in LPG service.
2,555,809 (Ingersoll-Rand Co.)—Compressor of the multiple cylinder, reciprocating piston type.

Valves and Fittings

2,555,367 (C. Lynn Peterson)—Control valves for vacuum and pressure systems of filters.
2,556,680 (Grove Regulator Co.)—Flow control valve of small capacity.
2,556,904 (Mueller Co.)—Check valve.
2,557,187 (Black, Sivalls & Bryson, Inc.)—Pressure regulating valve.
2,557,257 (Scovill Mfg. Co.)—Device for controlling time duration for operation of a valve.
2,557,375 (Ingersoll-Rand Co.)—Self-cleaning strainer for fluids.
2,557,514 (General Controls Co.)—Fluid control valve.
2,557,536 (Phillips B. Drane and Clarence D. Laadley)—Relief valve.
2,558,247 (L. S. Hulmer and Paul A. Dewhirst)—Flow control fitting for a blind plate.
2,558,387 (General Controls Co.) — Liquid sampler.
2,558,509 (Grove Regulator Co.)—Motor operated flow control valve with a pneumatic valve positioner.

Tools

2,556,694 (Har-Jo Research Corp.)—Pipe cutter with spring-urged pressure roller.
2,556,974 (Nye Tool Co.)—Pipe cutter with special guide rollers.
2,557,202 (Black, Sivalls & Bryson, Inc.)—Tool for applying repair plates to pipe lines.

Packing and Seals

2,555,492 (Ingersoll-Rand Co.)—Pressure fluid seal for rotary shafts.
2,555,675 (The Garlock Packing Co.)—Sealing device for rotary shafts.
2,555,932 (Bump Pump Co.)—Rotary seal for shafts.

Instruments

2,555,327 (Myron A. Elliott)—Gas analyzer of the infra-red radiation absorption type.
2,555,593 (The Vapor Recovery Systems Co.)—Testing apparatus for tank gauging lines.
2,555,629 (Ralph N. Brodie Co.)—Two-cylinder fluid flow meter of the rotary vane type.
2,556,337 (General Controls Co.)—Electromagnetic reset valve for fluid fuel supply systems.
2,556,344 (Martin Silge)—Refractometer employing the principle of total reflection.
2,556,346 (Bror Wilhelm Stromberg)—Level indicator for liquid-containing vessels.
2,556,436 (Moore Products Co.)—Pneumatic pressure controller.
2,556,752 (Tide Water Associated Oil Co.)—Automatic reflux ratio control for distillation columns.
2,556,893 (Minneapolis-Honeywell Regulator Co.)—Flow integrating meter.
2,556,832 (Minneapolis-Honeywell Regulator Co.)—Gas analyzer, particularly a system for cleaning the gas sample prior to analysis.
2,556,872 (Red Jacket Mfg. Co.)—Liquid level control system, particularly for brine tank in a base-exchange type of water treating unit.
2,557,007 (Clarence W. Paulsen)—Pipe flow recorder for use where flow is pulsating.
2,557,008 (Ralph Poole, London, England)—Apparatus for detecting explosive gases.
2,557,070 (Consolidated Engrg. Corp.)—Linear simultaneous equation solver.
2,558,356 (Daneiger Oil & Refining Co.)—Pressure control device.

Tanks and Vessels

2,556,497 (Jerry E. Hobson)—Removable free sump for storage tank bottoms.
2,557,990 (Chicago Bridge & Iron Co.)—Vessel designed for external pressure.
2,558,804 (Karl M. Spegt)—Storage tank for flammable materials incorporating cooling and fire control structure.

Fire extinguishers

2,555,304 (Daniel M. Butler)—Foam generating attachment for fog nozzles.
2,557,129 & 2,557,162 (The Fyr-Fyter Co.)—Fire extinguisher containing a collapsible tube for the extinguishing agent.
2,558,409 (C-O Two Fire Equipment Co.)—Discharge head for fire extinguishers.

Miscellaneous

2,556,514 (Socony-Vacuum Oil Co., Inc.)—Apparatus and method for hydrocarbon conversion, moving bed catalytic type.
2,557,360 (Samuel Pennella)—Protective ferrule for heat exchanger tubes.
2,558,194 (Universal Oil Products Co.)—Apparatus for the fluid catalytic conversion of different hydrocarbon feeds.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

If you want . . .

INCREASED THROUGHPUT

from existing processing equipment

Get the facts on . . .

METEX MIST ELIMINATORS

In plant after plant, these knitted-wire mesh units, by removing *more than* 95% of the entrained liquids, are enabling petroleum refiners to

. . . CUT PROCESSING COSTS
. . . MAINTAIN PRODUCT QUALITY
. . . AND INCREASE OUTPUT

Furnished in sections, and cut to fit the dimensions and shapes of towers and stills, Metex Mist Eliminators can be easily installed in existing equipment. Their effectiveness also leads to further economies on new construction.

For detailed information on this modern method of coalescing and removing liquids entrained in the vapor in vacuum pipe stills, scrubbing towers, knockout drums, evaporators and similar equipment, write for your copy of our 8-page bulletin — "Metex Mist Eliminators".

METAL TEXTILE CORPORATION
631 EAST FIRST AVENUE, ROSELLE, N. J.

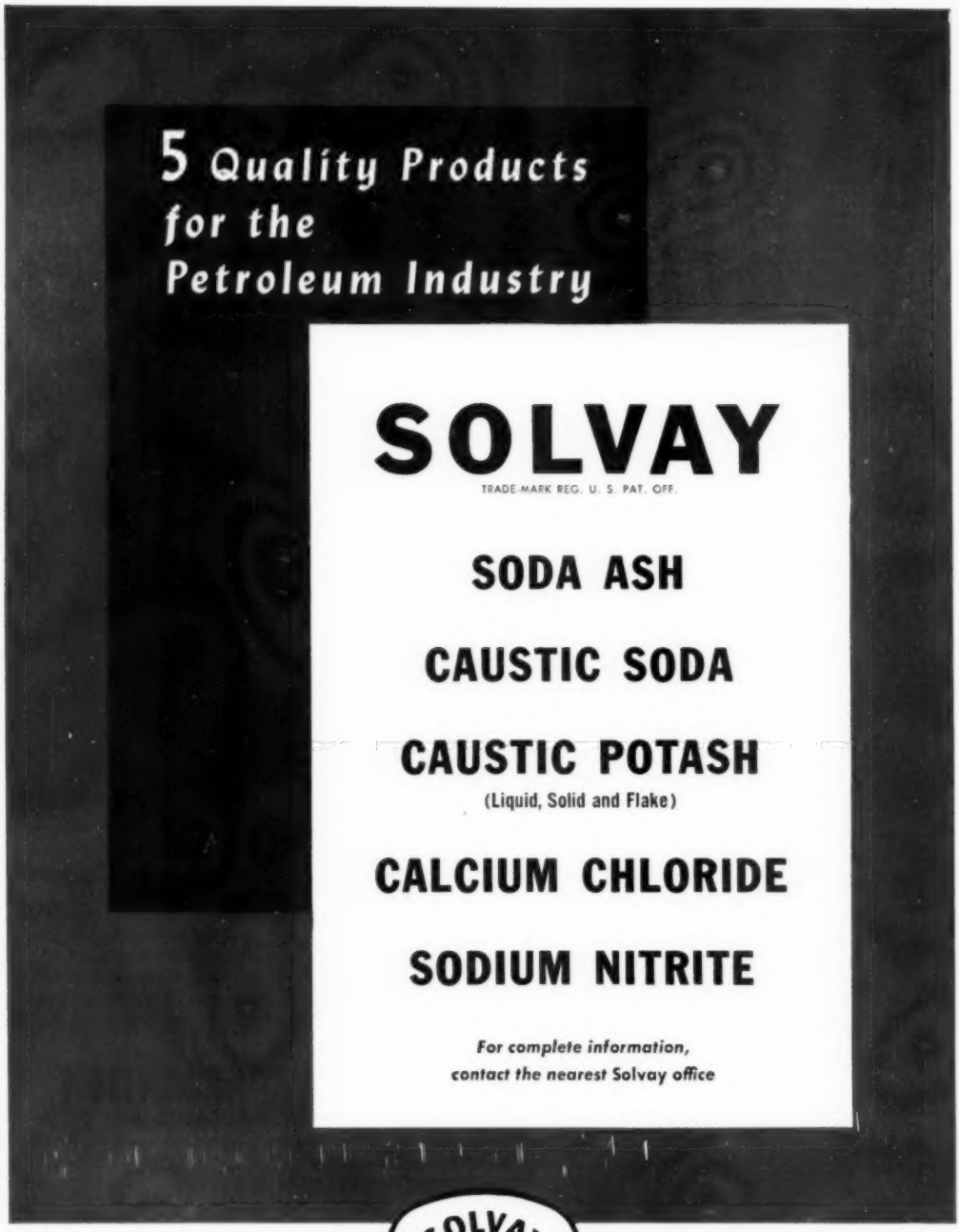
Metal Textile Corporation
631 East First Avenue, Roselle, N. J.

Gentlemen:

I'd like to have a copy of "Metex Mist Eliminators".

Name ..... Title .....
Company .....
Address .....
City ..... State .....

(*To obtain more data on advertised products see page* 908)



Soda Ash · Caustic Soda · Caustic Potash · Nytron · Calcium Chloride
Chlorine · Potassium Carbonate · Sodium Bicarbonate · Formaldehyde
Specialty Cleansers · Ammonium Bicarbonate · Sodium Nitrite
Para-dichlorobenzene · Ortho-dichlorobenzene · Monochlorobenzene
Ammonium Chloride · Methanol

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100 YEARS OF SERVICE
1851 1951

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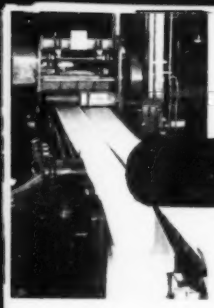


NEWS OF SUPPLIERS

Manufacturers
Distributors
Engineering Firms

Davison Fills Technical Posts

Appointments to technical posts in The Davison Chemical Corp. as announced recently by Dr. Paul W. Bachman, director of research and development, are as follows:

Dr. Clary

Joe D. Clary has been named superintendent of the specialty catalyst plant operated at Curtis Bay (Baltimore). Dr. Clary received his B.S. and M.S. in chemistry from Emory University, 1930-31, and his Ph.D. from Ohio State in 1938. He comes to Davison from the Chemical Products Corp., Cartersville, Ga., where he was technical director.

Dr. Cooper

Albert H. Cooper has been appointed head of the research engineering dept. of the research and development division. He received his B.S. and M.S. from the University of Tennessee, and his Ph.D. in chemical and mechanical engineering from Michigan State. A registered professional engineer in Virginia, Maryland, and Pennsylvania, Dr. Cooper has come to Davison from Bucknell University where he was head of the department of chemical engineering.

Fisher Names Development Head

To head up expanding facilities, Fisher Scientific Co. has appointed Samuel W. Levine as director of development. A researcher in X-ray and emission spectroscopy, the properties of petroleum reservoirs, and hydrocarbon thermodynamics, Dr. Levine was also active in the development of pioneer microwave radar systems during World War II at MIT Radiation Laboratory.

He taught at Texas A & M College, from which he holds two degrees B.S., 1938, M.S., 1941. His doctoral dissertation, M.I.T., 1948, "The Compressibility of n-Pentane," is currently awaiting publication. Dr. Levine's industrial experience includes: combustion engineer, Lone Star Gas Co., U. S. Air Force captain; and associate chemist, Atlantic Refining Co.

E. B. Badger—Stone & Webster

Activities formerly engaged in by E. B. Badger & Sons Co. and Stone & Webster Engrg. Corp.'s process division will now be carried on by the Badger Process Division of Stone & Webster Engrg. Corp. These activities consist of engineering and construction services for the chemical, petrochemical, petroleum, and pharmaceutical industries.

Erastus B. Badger, who has been president of the firm, has been elected a director of Stone & Webster. Ralph D. Waterman, formerly vice president of the Badger Company, has become a vice president of Stone & Webster.

De Laval Appoints Executives

The following four executive promotions have been made recently by the De Laval Steam Turbine Co.: James P. Stewart to president from executive vice president; Wencel A. Neumann, Jr. to vice president of industrial sales; H. G. Bauer to vice president of engineering from vice president and executive engineer; Charles A. Jurgenson to vice president of manufacturing.

Mr. Stewart

Mr. Neumann

Mr. Stewart came with the company in 1946, and was elected executive vice president in 1949. A mechanical engineering graduate of Cornell, he is a member of several professional engineering societies. At present he is also president of the Hydraulic Institute, a trade association of the pump manufacturing industry.

Mr. Neumann has been associated with De Laval since 1946, and most recently as manager of the IMO-De Laval Products Division. Previously he was with Westinghouse Electric Corp., and also served as an officer in the U. S. Army Ordnance. He is an engineering graduate of Michigan and is active in several industrial associations.

American Meter Elects Diehl

John C. Diehl, president of American Meter Co. since August, 1950, has been elected chairman of the board of directors. In other management changes, Donald C. Wiley has been appointed vice president in charge of research, and Archie E. Weingard has been appointed vice president in charge of production.

Mr. Diehl

Mr. Wiley

Mr. Weingard

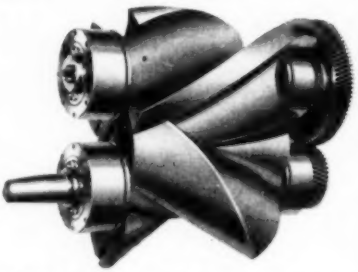
Mr. Diehl, who joined the firm in 1919 as an engineer, is a graduate of M.I.T. He was made chief engineer in 1929, and in 1934 he was elected a director of the company. He was made vice president in 1943. A member of the American Gas Association and the Gas Appliance Manufacturers Association, Mr. Diehl is author of several books and articles on the gas industry, including the Natural Gas Handbook.

Mr. Wiley became associated with American Meter in 1947 when he supervised the expanding activities of the main research laboratory in Erie, Penna. He is a 1931 graduate of Purdue, and from that time until joining American Meter he was employed by John J. Nesbitt, Inc.,

The STANDARDAIRE
PRECISION BUILT
Axial Flow BLOWER

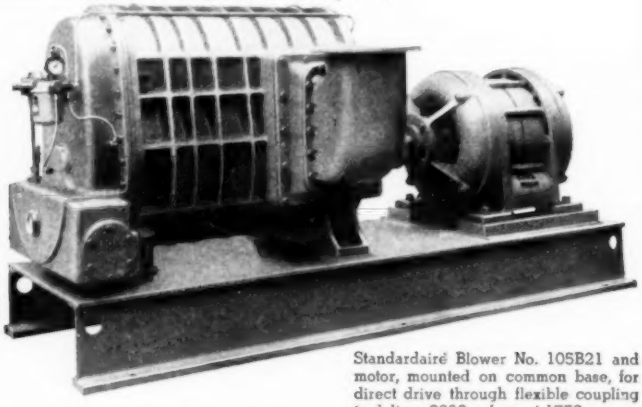
Features Two More Vital Components:

PRECISION ROLLER BEARINGS—spherical type are used on the fixed ends of the rotor shafts and a cylindrical type on the floating ends. With such a design free aligning action of the rotor shafts is assured and specific speed, load, and service requirements are easily met. In addition, this bearing construction fully compensates for any housing distortion which might occur due to temperature differentials.



LABYRINTH TYPE OIL SEALS—Bearings and gears are lubricated by a spray of filtered oil. The oil is controlled by a balanced pressure, labyrinth type seal which gives complete oil control and assures absolutely clean air delivery under all operating conditions.

Such features as precision bearings—frictionless oil seals—hardened, shaved, helical gears—contribute immeasurably to the efficient and dependable performance of the Standardaire Blower—A Modern Machine with Superior Operating Characteristics. For further information write READ STANDARD CORPORATION, Dept. E-58, 370 Lexington Avenue, New York 17, N. Y.



Standardairé Blower No. 105B21 and motor, mounted on common base, for direct drive through flexible coupling to deliver 3200 c. f. m. at 1750 r. p. m.

BLOWER-STOKER DIVISION

FORMERLY The Standard Stoker Co., Inc. ONLY THE NAME IS CHANGED

READ STANDARD CORPORATION

NEW YORK • CHICAGO • ERIE • YORK • LOS ANGELES

(To obtain more data on advertised products see page 908)

News of Suppliers

Phila., Penna., as production manager.

Mr. Weingard also joined the firm in 1947, as supervisor of methods. A graduate of the General Electric Technical Engineering School, he then spent 16 years with GE in various production and supervisory posts. From 1943 to 1947, Mr. Weingard was superintendent of production control at Lord Manufacturing Co.

Gertz Becomes Purvin Partner

Robert L. Purvin, consulting chemical engineers of Dallas, has announced the advancement of Melvin H. Gertz to partner in the organization. The firm will henceforth be known as Purvin and Gertz, Consulting Engineers. Personnel will remain unchanged and offices are to stay at 510 Reserve Loan Life Bldg. in Dallas.

Mr. Gertz has been associated with the company for the past four years as process consultant and project engineer. Prior to that time he was on the engineering staff of Humble Oil & Refining Co. Purvin and Gertz specializes in process design and control engineering and operating management, and economic evaluations and appraisals in the oil, gas, and petrochemical industries.

Roots-Connersville Blower Expands

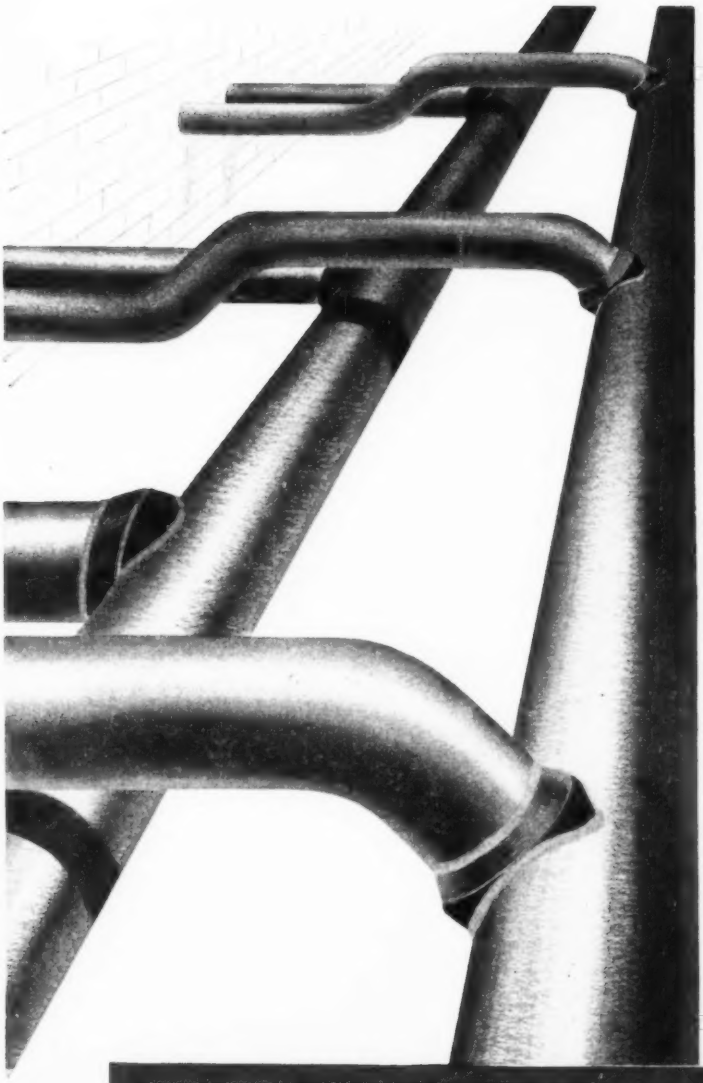
Investment of $1,500,000 in a construction program covering new erection floor, expansion of present test facilities, manufacturing space, and machine tools will be undertaken by Roots-Connersville Blower Corp., Connersville, Ind. The new facilities will enable the company to test the largest centrifugal blowers and compressors ever designed, which it is now building. Among the units in this order, one unit will require a total load of 56,000 hp. on a single shaft.

Movie on Process Instrumentation

Under the title, "Information At Work," Taylor Instrument Cos. has released a new, narrated, 30 minute, 16 mm., color motion picture telling the story of the growth and significance of process and industrial instrumentation. Taylor is handling the distribution of the film and requests for loan by technical societies, instrument engineers, civic clubs, etc. should be addressed to Public Relations Dept., Taylor Instrument Cos., 95 Ames St., Rochester 1, N. Y.

Personnel Changes

Atlas Mineral Products Co. Edison C. Sickman, to general sales manager from sales coordinator; Donald F. Deakin and Gerald F. Gilbert, Jr., to assist Mr. Sickman; Earl A. Erich to head technical service activities; George Gabiel to plant manager as well as engineering coordinator;



WELDOLETS

WELDING FITTINGS FOR ANY PIPING SERVICE

NATURAL GAS COMPRESSOR STATION PIPING CONSTRUCTED ECONOMICALLY AND EFFICIENTLY USING WELDOLET WELDING FITTINGS THROUGHOUT

This installation, together with a number of important applications of WeldOlet Welding Fittings in various types of service is shown in the new Bonney W-3 WeldOlet Catalog.

The completely new Bonney catalog will furnish descriptions, dimensional information and installation instructions. The technical section demonstrates graphically how WeldOlet Welding Fittings offer the quickest, surest and most economical method of reinforcing and maintaining 100% pipe strength at branch connections in accordance with code provisions.

Write for your free copy to: **BONNEY FORGE & TOOL WORKS** *168 Green St., Allentown, Pa.*

Export Distributors: NATIONAL SUPPLY EXPORT CORP., 600 Fifth Ave., New York 20, N. Y.

WECO "Junior"

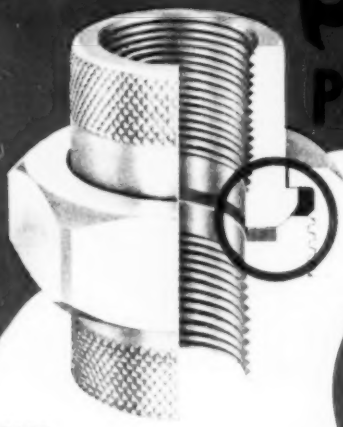
FIGURE 342

the union with the

PROTECTED

BALL AND CONE

Seal



Weco "Junior" unions give you a plus value for extra long service and repeated make-up and break-out without danger of leaks. It's the replaceable gasket which protects the famous Weco ball-and-cone seal from corrosive or abrasive action of line fluids and gases. It prevents the possibility of turbulence in the space between the sub ends. With this protection, the ball-and-cone sealing surfaces of the union retain their original finish and leak-proof far beyond normal expectation. The gasket may be made from virtually all standard gasket materials, thus the Weco "Junior" is applicable for a wide range of services.

The Weco "Junior" has heavy acme threads for faster, easier starting . . . easy break-out. They will not seize. The walls of the sub-ends are heavier and stronger than usually found in unions of this type.

Weco "Juniors" are 3000 lb. non-shock, C.W.P. unions, available in sizes ⅛" through 2" with machine finish or Weco-lyte Cadmium Plated.

OTHER PLUS FEATURES

Weco "Junior" Unions are packed in cartons of 12 (1¼" and larger) and 24 (1" and smaller). This added feature protects the union . . . makes them easier to stock . . . simplifies inventorying.

ASK YOUR INDUSTRIAL, MILL SUPPLY OR OIL FIELD SUPPLY STORE FOR WECO "JUNIOR" UNIONS BY THE CARTON.

WECO

WELL EQUIPMENT MFG. CORP.

Subsidiary of Chiksan Company

HOUSTON 1, TEXAS

Exclusive Sales Representative Outside Mid-Continent Area

CHIKSAN COMPANY

Brea, Calif. Chicago 3, Ill. Newark 2, N. J.

Export Sales: CHIKSAN EXPORT COMPANY, Brea, Calif. Newark 2, N. J.

Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

News of Suppliers

George Kanelis to assistant plant manager; and Raymond Trollinger to plant superintendent.

M. W. Kellogg Co. — Russell J. Wolf to vice president in charge of sales from assistant to the president; Donald W. Champlin to vice president in charge of manufacturing from general manager of the Equipment Mfg. Div., Continental Can Co.

Centrifix Corp.—Charles L. Campbell to chief engineer from chief engineer, Diamond Alkali Co.

Rockwell Mfg. Co.—John B. Link to valve engineer for the southern California territory from Southwestern Engrg. Corp.; Orville Cochran to supervisor of Gas Products and Nordstrom Valves in the Rocky Mt. area from sales engineer in Kansas City territory.

Bridgeport Brass Co.—L. E. Menns to Pacific Coast sales manager from district manager in Los Angeles.

The Girdler Corp.—Dr. H. W. Fleming to the research and development dept. to direct catalyst development program, from a post as group leader in Phillips Petroleum Co.'s research and development dept.

Expansion, Transition

Koch Engineering Co., formerly at 335 West Lewis St., Wichita, Kans., has moved to new and larger quarters at 321 West Douglas, where they will occupy the entire second floor.

Construction is underway on an $8,500,000 expansion of chlorine and caustic soda producing facilities at the Natrium, W. Va., plant of **Pittsburgh Plate Glass Co.,** operated by the subsidiary, **Southern Alkali Corp.** Plant will be completed in 18 to 20 months.

Airetool Mfg. Co. has acquired the **Ajax Expander Co.** of Fairview, Penna. Manufacturing facilities and inventory of Ajax has been moved to Airetool's Springfield, Ohio, plant. Production and sales will continue on Ajax line of tube expanders as well as Airetool's own products.

Babcock & Wilcox Co. will move next spring its executive headquarters to five floor space in new Chrysler Bldg. East, New York City, a 32-story structure now building next to existing Chrysler Bldg. Present B&W offices are in Singer Bldg., 85 Liberty St., New York.

Wall Colmonoy Corp., Detroit, has opened a new office and warehouse in the southwest, at 5815 Clinton Drive, Houston 1, Texas. Henry L. Howard has been appointed manager.

This STUD Saves You Money

The stud shown above is the Bethlehem Continuous-Thread Tap-End Stud. Put it to work where excessive strain and vibration are encountered, and it will save you money.

The Bethlehem Continuous-Thread Tap-End Stud is economical, even when used in the most difficult bolting jobs, because of the way it resists fatigue-failure. As the stud has no point of thread runout, the stress concentrations usually encountered are distributed over its entire working length, rather than being permitted to bunch up at any one point.

This stud also has two types of threads, making it ideal for installations requiring but one nut. The chamfered tap-end of the stud is threaded to Class 5 fit, and its rounded nut-end is threaded to either Class 2, 3, or 7 fit. Yet so expertly are the threads blended that we challenge you to detect the point where the change occurs.

The Bethlehem Continuous-Thread Tap-End Stud is made from carbon or alloy steel, and can be furnished heat-treated. It comes in diameters from $\frac{1}{4}$ in. to $1\frac{1}{4}$ in., and in virtually any length.

Put the Bethlehem Continuous-Thread Tap-End Stud to work, and you'll soon agree that it exceeds your highest expectations. If you'd like to have our representative call to discuss the stud in detail, please write to us at Bethlehem, Pa.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Bethlehem supplies every type of Fastener

Alcoa Heat Exchanger News

Published by Aluminum Company of America

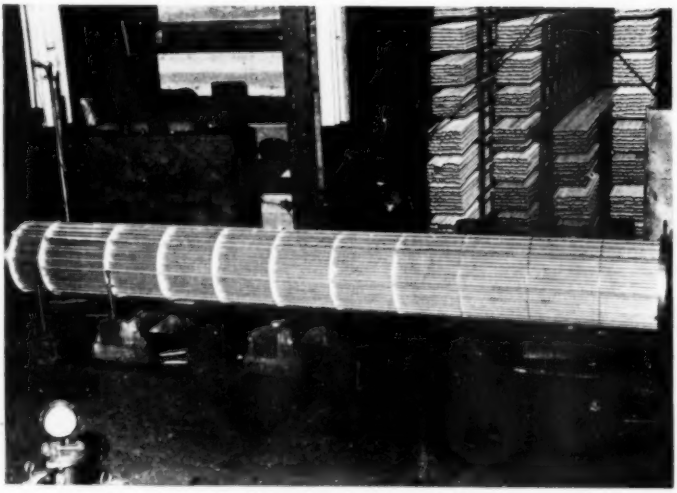
Rearmament needs severely limit the manufacture of aluminum heat exchanger tubes. But we realize that the purchase of refinery and processing equipment requires long study of economic and performance factors. That is the reason for this message.

El Paso Natural Gas Company Saves ⅓ in Cost of Glycol-Amine Exchanger Tubes

About three years ago, the Fluor Corporation started investigation in corrosion problems occurring with steel exchanger tubes in gas-treating plants utilizing Fluor's glycol-amine process. They conducted extensive research to find suitable replacements for steel. (Results of these tests were reported in the April, 1950, and February, 1951, issues of "Petroleum Refiner" Magazine.) Aluminum and 4-6 cr., ½ moly. steel tubes were most economical of the corrosion-resistant materials tested.

So when Fluor Corporation was selected to engineer glycol-amine exchangers at one of the large new plants of El Paso Natural Gas Company, they recommended Alcoa 58-H14 aluminum tubes for the service. These tubes cost 50 per cent less than seamless mild steel and 60 per cent less than 4-6 cr., ½ moly. steel. Fabrication of the units was done by Griscom-Russell.

Aluminum heat exchanger tubes have been so successful in resisting corrosion in glycol-amine plant service that over 100,000 pounds of aluminum are now used in that service. Experimental work has indicated over one year of service with no sign of corrosion. In handling, shipping and fabricating costs, the aluminum tubes saved 200,000 pounds over the heavy metal tubes they replaced. Their greater ductility permits easier roll-in.



ALCOA OFFERS BOOKLET

This 24-page booklet will answer many of your questions about Alcoa Tubes. It covers fabrication techniques, alloy selection, chemical and petroleum applications. It describes tube cleaning, inhibitors, cathodic protection. It contains complete information on fluid flow and heat transfer. There are formulas, tables and specification data. Write for your free copy today. ALUMINUM COMPANY OF AMERICA, 1863H Gulf Bldg., Pittsburgh 19, Penna.

THESE APPLICATIONS ARE NATURALS FOR ALUMINUM TUBES:

Petroleum

- Condensers handling hydrocarbon fractions such as gasoline, naphtha, gas, oil, etc.
- Vapor recovery condensers
- Lube oil coolers
- Natural gas compressor aftercoolers
- TCC overhead condensers
- Recompressor aftercoolers
- Hydrogen sulfide gas coolers
- Furfural condensers and heat exchangers
- Propane chilling
- Wax sweaters
- Lean oil—rich oil exchangers
- Amine solution coolers
- Glycol-amine solution coolers and heat exchangers.

Chemical

- Butanol
- Ethanol
- Ethylene Glycol
- Glycerin
- Hydroabietyl
- Isopropanol
- Methanol
- Phenol
- Propylene Glycol
- Acetaldehyde
- Formaldehyde
- Furfural
- Heptaldehyde
- Acetic acid
- Butyric acid
- Stearic, Palmitic, Maleic Oleic acids
- Naphtha
- Ricinoleic acid
- Acetanilide
- Ammonia
- Hydrogen Cyanide
- Nitric acid (concentrated)
- Pyridine
- Hydrogen Sulfide
- Benzene
- Dichlorobenzene
- Gasoline
- Gelatin
- Hydrogen Peroxide
- Turpentine
- Xylene

(To obtain more data on advertised products see page 908)

Biological Methods for Treating Wastes On Special Symposium of API Group

A SPECIAL technical symposium on the "Biological Oxidation of Refinery Wastes" will be held Tuesday morning, Sept. 11, by the Committee on Disposal of Refinery Wastes of the American Petroleum Institute at the Park Lane hotel in Denver.

The symposium will follow a 2-day meeting of the committee itself, scheduled for Sept. 9 and 10. Although the committee meeting is closed to members, the symposium is open to anyone interested, according to L. C. Burroughs, Shell Oil Co., chairman.

Preliminary plans for the symposium are to have four or five papers. One will give a general summary of the subject of biological oxidation of wastes. The others will describe pilot plant operations, plant design consideration, and a commercial installation.

ISA—6th Annual Meeting

ONCE again, papers of interest to petroleum processing men will dominate the technical program of the Annual Instrument Conference and Exhibit, being held by the Instrument Society of America and cosponsoring societies in Houston, Sept. 10-14.

In the nine ISA sessions on the program, 25 papers will be presented including coverage of instruments for process control, analysis, testing, and the maintenance and operation of instruments. Among the three sessions of the Instruments & Regulators Division of the ASME will be a symposium on servo-mechanisms. This year Texas A & M College's annual symposium on instrumentation for the process industries is to be part of the general Instrument Conference, and it will include seven papers in three sessions.

WPRA—Regional Meeting

A LARGE group of refiners is expected to be on hand for the Alma, Mich., regional technical meeting of the Western Petroleum Refiners Assn. Aug. 17. The sessions will be held in the auditorium of Leonard Refineries, and include papers on industrial relations, aviation fuels and corrosion.

A special bus for those making advance reservations with WPRA will leave the Olds Hotel, Lansing, at 8:15 a.m. for the Alma meeting.

ACS—Diamond Jubilee

A TWO-DAY symposium on 25 Years of Progress in Petroleum Technology has been arranged by the American Chemical Society Division of Petroleum Chemistry, as a feature of the ACS Diamond Jubilee Meeting in New York, Sept. 3-7. The symposium will be Sept. 5-6. Dr. R. E. Wilson, chairman of the board, Standard Oil Co. (Indiana), will preside at all sessions.

Some 30 papers will be presented by refining technologists and others covering a wide range of refining subjects. Included will be catalytic cracking and catalytic reforming, alkylation and isomerization, synthetic liquid fuels, solvent extraction, dewaxing and deasphalting, lubricating oil manufacture, asphalts and waxes, petroleum coke, aromatics, plastics, synthetic detergents from petroleum and others.

The annual Petroleum Division Dinner will be Sept. 5.

Oil Man's Calendar

AUGUST

17, Western Petroleum Refiners Association, regional meeting, Leonard Refineries, Inc., auditorium, Alma, Mich.

29-Sept. 1, Scientific Apparatus Makers Ass'n., summer meeting, Laboratory Equipment Section, Northernaire Hotel, Three Lakes, Wisc.

SEPTEMBER

3-7, American Chemical Society, Diamond Jubilee meeting, Hotel Statler, New York City.

9-13, 12th International Congress of Pure and Applied Chemistry, Hotel Statler, New York City.

10-14, Instrument Society of America, Sixth National Conference and Exhibit, Coliseum, Houston, Texas.

11, American Petroleum Institute Committee on Disposal of Refinery Wastes, Technical Session on Methods of Biological Treatment of Wastes, Park Lane Hotel, Denver, Colorado.

12-14, National Petroleum Assn., Hotel Traymore, Atlantic City, N. J.

16-19, American Institute of Chemical Engineers, regional meeting, Sheraton Hotel, Rochester, N. Y.

20-21, Western Petroleum Refiners Association, regional meeting, Hotel Henning, Casper, Wyo.

24-26, American Society of Mechanical Engineers, petroleum mechanical engineering conference, Tulsa, Okla.

25-28, American Society of Mechanical Engineers, fall meeting, Radisson Hotel, Minneapolis, Minn.

OCTOBER

1-5, California Natural Gasoline Assn., 26th annual fall meeting, Ambassador Hotel, Los Angeles.

8-10, American Oil Chemists' Society, fall meeting, Edgewater Beach Hotel, Chicago, Ill.

8-12, National Safety Council, 39th national congress and exhibition, Hotel Stevens, Chicago.

9-12, Scientific Apparatus Makers Ass'n., midyear meeting, Recorder-Controller Section, Seaview Country Club, Absecon, N. J.

14-20, OIL PROGRESS WEEK.

14-20, Oil Industry Information Committee, Oil Progress Week meeting, Roosevelt Hotel, New Orleans, La.

15-17, American Gas Association, annual convention, Kiel Auditorium, St. Louis, Mo.

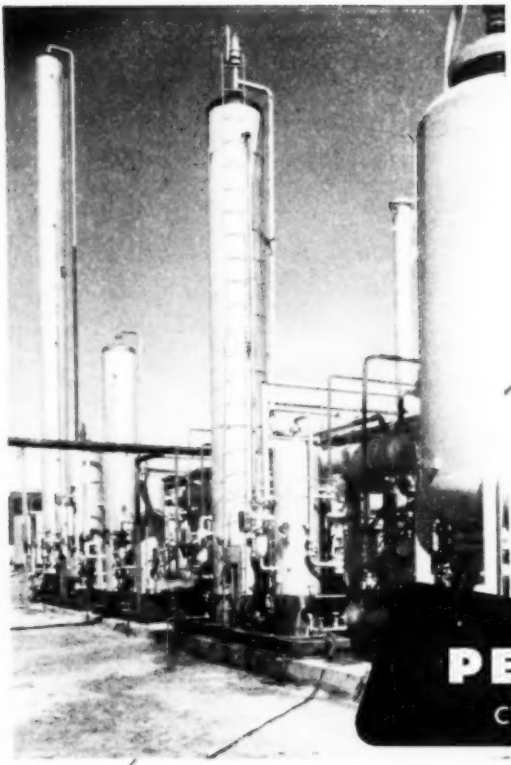
PLAN TO ATTEND

The Instrument Industry through the necessities of the present emergency has reached a high peak of development, and is ready to consult with you and your engineers and operating men on the baffling problems of efficiency and economy, which are fast becoming the real headaches of plant operation.

Post yourself on the latest advances in instrumentation by attending. Bring your engineers and operating executives. No charge—admission by registration only.

Write for preliminary program to the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, Pa.

(To obtain more data on advertised products see page 908)



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AT GLADEWATER TEXAS

CYCLOVERSION —
FOR LOW OPERATING COST

SKID-MOUNTED —
FOR LOW INSTALLATION COST

PREFABRICATED —
FOR LOW CONSTRUCTION COST

Gladewater Refining Company recently installed this Perco Cycloversion unit to reform straight run gasoline or desulfurize cracked stocks at the rate of 600 barrels per stream day. Engineering and construction were by Grebe & Doremus Process Co., Houston, who shop fabricated the unit and mounted it on three skids for installation on site. Write us about Cycloversion for you!

A SERVICE MARK

PERCO DIVISION
PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, OKLAHOMA

REFINING TRENDS

Current Data on Crude Runs, Product Supply and Demand

Heating Oil Stocks East of California Within 6,255,000 Bbls. of 1950 Peak

THE volume of storage for products still available at refineries and terminals will likely be the determining factor in refining operations in the coming weeks, unless there is some radical change in the international situation.

Stocks of principal products at U. S. refineries, including unfinished oils, were over 330,000,000 bbls. at the end of July. At the same date a year ago they were only a little above 300,000,000 bbls. and 331,000,000 bbls. was the highest figure reached, at the end of November. While there are currently heavy drafts on gasoline stocks at refineries, stocks of heating oils (kerosine and distillates) are building up rapidly. The volume of stocks of products normally builds up until into November, and the accelerated movement this year will give refiners this fall by far the largest total volume of stocks on record.

In normal times this situation would call for some adjustment of operations on the part of the industry. However, these are not normal times, and the present high rate of refining operations is justified in the face of international conditions, together with the fact domestic consumption is growing. Therefore, it seems apparent that the amount of storage still available to refiners will be a decisive factor in the rate of plant operations in coming weeks.

Heating oil stocks in the U. S. as of the end of July were only about 10,000,000 bbls. under the peak published figure of 1950, reached at the end of October. For the area east of California, these stocks at the end of July were 6,255,000 bbls. under the peak of 101,250,000 bbls. of Oct. 31, 1950. Table 1, which lists heating oil stocks by districts as of July 28, API basis, shows that one district, Ind.-Ill.-Ky., on that date had more heating oil in storage than at the end of October, 1950. In the Okla.-Kans.-Mo. district the difference was only nominal.

The rate of heating oil output at refineries in July was 18.5% above July a year ago. Production for six months of 1951 was nearly 29% higher than in the same period in 1950. Indicated heating oil demand at refineries in July, however, was only 7.5% higher than for the previous July and demand for 6 months was 16.5% higher.

Withdrawals of gasoline from refinery stocks in July reflect the calls on plants in this country to replace the material normally coming from the Abadan refinery in Iran, as well as high domestic consumption. Indicated motor fuel demand at refineries in July was close to 3,390,000 b/d. Gasoline stock withdrawals from refineries in July were at the indicated rate of around 170,000 b/d, as compared with around 40,000 b/d in July, 1950. This accelerated rate of withdrawals will likely continue through August and perhaps later. Total withdrawals of refinery stocks of gasoline since March 31 through July 28 have been around 17,300,000 bbls. for the area east of California; while a year ago to the end of July they were about 17,900,000 bbls. However, stocks started the withdrawal season this year with about 10,000,000 bbls. more in storage on March 31 than a year ago.

Crude runs to refinery stills in July were about 10% higher than in July a year ago, when the Korean war was just starting to accelerate refinery operations. Runs in August of 6,600,000 b/d are forecast by the Bureau of Mines, compared with indicated runs of 6,490,000 b/d in July.

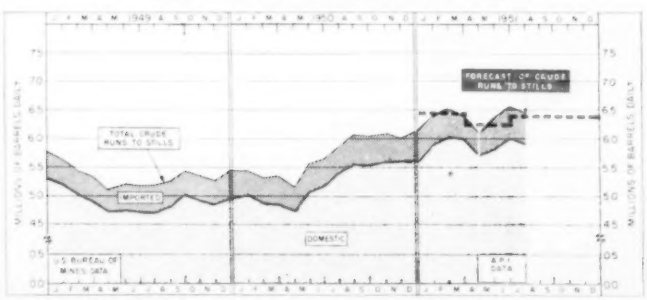
Table 1—Heating Stocks (Kerosine and Distillate Fuels) by Refining Districts

(1000 Bbls., Bureau of Mines Data)

District	July 31, 1950	Oct. 31, 1950	July 28, 1951*	Dif. from 1950 High
East Coast	24,188	37,374	33,744	3,630
Gulf Coast	19,347	24,221	20,614	3,607
Total Coastal	43,535	61,595	54,358	7,237
Appalachian	1,139	1,790	2,325	535
Ind.-Ill.-Ky.	15,178	21,152	22,565	1,413
Okla.-Kans.-Mo.	7,529	10,777	10,597	180
Inland Texas-La.	2,677	3,325	3,071	254
Rocky Mountain	2,347	2,610	2,078	532
Total U. S. except Cal.	72,405	101,249	94,994	6,250
California	13,191	12,686	8,903	3,783
Total U. S.	85,596	113,935	103,897	10,038

* API basis.

Fig. 1—Runs to Stills Ease Off in July



Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
July '51 API*	5,205	1,285	6,490
July '50 BM	5,416	467	5,883
Change	-211	+818	+607
% Change	-3.9	+175.4	+10.3

* Through July 28.

Total (1000 bbls.)
(Bureau of Mines Data)

7 Mo. '51*	5,973,405	911,431	6,884,836
7 Mo. '50	5,501,574	814,837	6,316,411
Change	+471,831	+96,594	+568,425
% Change	+8.6	+11.9	+9.0

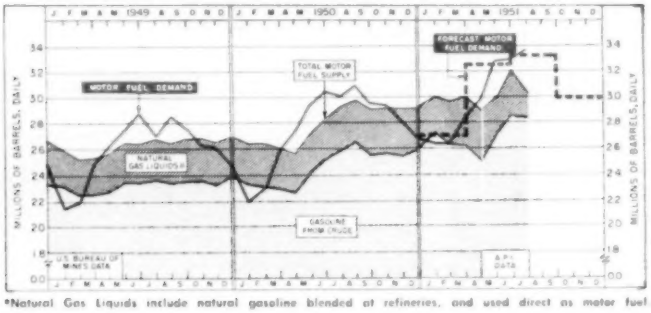
* June from API data.

BM Forecast of Runs to Stills, 1951
(revised June 12, 1000 b/d avg. by Quarter)
1st Q., 6,162; 2nd Q., 6,603; 3rd Q., 6,430; 4th Q., 6,815.

Yields on Crude Runs to Stills

	Gasoline	Kerosine	Dist. Fuels	Resid. Fuels
	%	%	%	%
July '51, API	43.6	9.5	29.0	13.9
June '51, API	42.8	9.6	28.7	13.9
May '51, BM	42.8	9.4	28.8	13.6
June '50, BM	41.3	7.6	27.7	13.8

Fig. 2—Motor Fuel Demand Nears 3,400,000 B/D



*Natural Gas Liquids include natural gasoline blended at refineries, and used direct as motor fuel.

Fig. 3—"Gas" Stocks Not Falling at '50 Rate

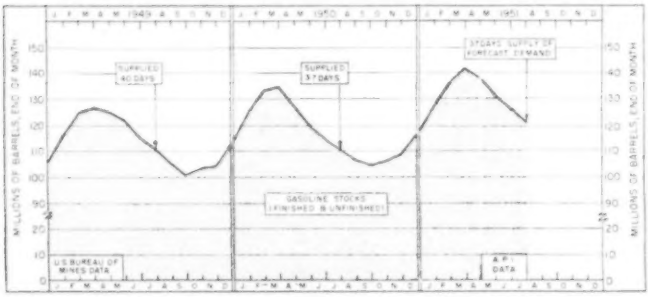

SUPPLIED 40 DAYS
SUPPLIED 37 DAYS
STOCKS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
A.P.I. DATA
MILLIONS OF BARRELS, END OF MONTH

Fig. 4—Heating Oil Demand Starts to Pick Up

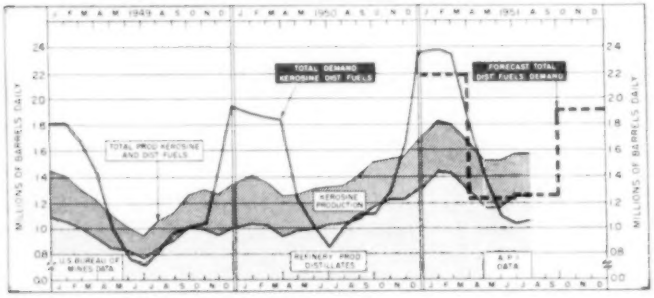
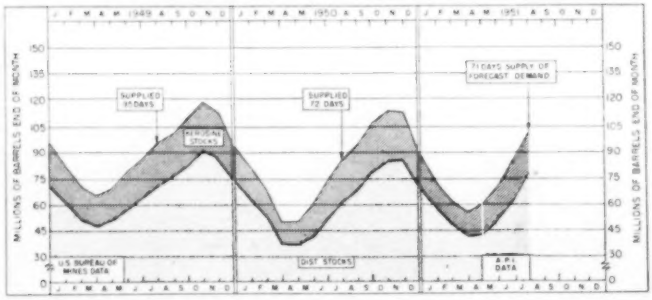

TOTAL DEMAND KEROSINE DIST. FUELS
FORECAST TOTAL DIST. FUELS DEMAND
TOTAL PROD. KEROSINE AND DIST. FUELS
KEROSINE PRODUCTION
REFINERY PROD. DISTILLATES
U.S. BUREAU OF MINES DATA
A.P.I. DATA
MILLIONS OF BARRELS DAILY

Fig. 5—Heating Oil Stocks Approaching '50 Peak



Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
July '51, API*	2,850	360	3,190
July '50, BM	2,592	344	2,936
Change	+258	+16	+254
% Change	9.2	4.6	8.6

* Through July 28

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mo. '51*	487,815	63,577	551,392
6 Mo. '50	426,931	57,067	483,998
Change	+60,884	+6,510	+67,394
% Change	14.3	11.4	13.9

* June from API data

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

July '51, API*	3,200
July '50, BM	3,022
Change	+178
% Change	12.2

* Through July 28

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mo. '51*	536,653
6 Mo. '50	480,245
Change	+56,408
% Change	12.1

* June from API data

BM Forecast of Motor Fuel Demand, 1951
(revised, June 1; 1000 bbl. avg. by Quarters)
1st Q., 2,730; 2d Q., 3,261; 3d Q., 3,317; 4th Q., 3,076

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

July '51, API*	121,156
June '51, API	126,844
May '51, BM	142,261
July '50, BM	111,051

* On July 28

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
July '51, API*	343	1,253	1,596
July '50, BM	295	1,046	1,341
Change	+52	+207	+255
% Change	17.7	19.7	19.0

* Through July 28

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mo. '51*	69,150	234,684	303,834
6 Mo. '50	57,824	181,621	239,445
Change	+11,326	+53,063	+64,389
% Change	19.6	29.2	26.9

* June from API data

Heating Oils Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuels	TOTAL
July '51, API*	245	835	1,080
July '50, BM	228	777	1,005
Change	+17	+58	+75
% Change	7.4	7.5	7.5

* Through July 28

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mo. '51*	64,912	241,547	306,459
6 Mo. '50	57,840	205,151	262,991
Change	+7,072	+36,396	+43,468
% Change	12.2	17.8	16.5

* June from API data

BM Forecast of Heating Oils Demand, 1951
(Kerosine and Distillates)
(revised, June 1; 1000 bbl. avg. by Quarters)
1st Q., 2,198; 2d Q., 1,220; 3d Q., 1,230; 4th Q., 1,902

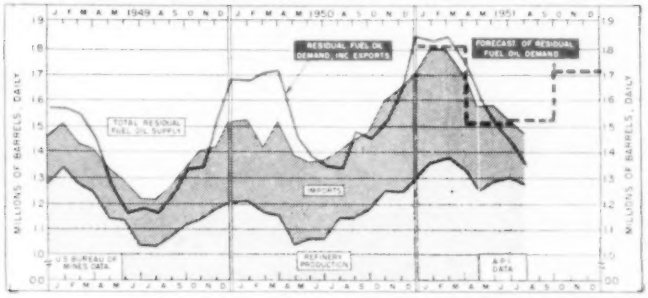
Heating Oil Stocks

(1000 bbls. end of month)

	Kerosine	Dist. Fuels	TOTAL
July '51, API*	26,959	76,938	103,897
June '51, API	24,142	65,700	89,842
May '50, BM	20,331	55,274	75,604
July '50, BM	23,151	62,555	85,706

* on July 28

Fig. 6—Residual Fuel Demand Continues to Drop



Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
July, '51, API*	1,290	196	1,486
July, '50, BM	1,140	269	1,409
Change	+150	−73	+77
% Change	13.1	27.1	5.4

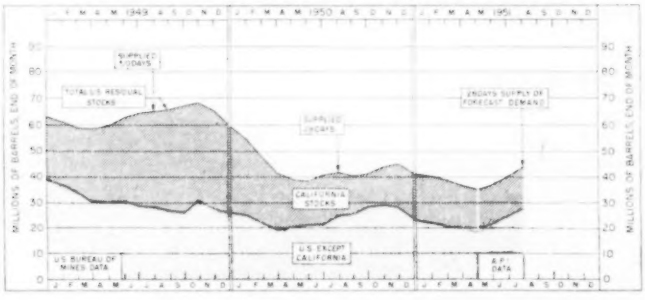
* Through July 28

Total (1000 bbls.)
(Bureau of Mines Data)

6 Mo. '51*	237,974	64,679	302,653
6 Mo. '50	202,515	57,596	260,111
Change	+35,459	+7,083	+42,542
% Change	17.5	12.3	16.4

* June from API data

Fig. 7—Moderate Gain in Residual Fuel Stocks



Residual Fuels Demand

Daily Average (1000 bbls.)

July, '51, API*	1,545
July, '50, BM	1,356
Change	+9
% Change	0.6

* Through July 28

Total Demand (1000 bbls.)

6 Mo. '51*	301,676
6 Mo. '50	282,690
Change	+20,926
% Change	7.4

* June from API data

BM Forecast of Residual Fuels Demand, 1951
(Revised, June 1, 1951—bbl. avg. by Quarters)
1st q., 1,828; 2d q., 1,722; 3d q., 1,931; 4th q., 1,728

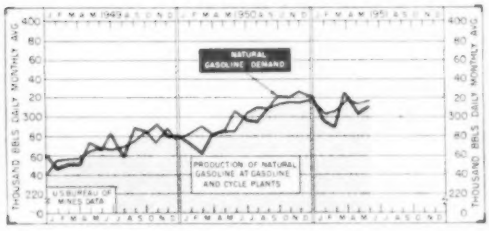
Residual Fuel Stocks

1000 bbls. end of month

	U. S. Except California	Total U. S.
July, '51, API*	28,902	44,957
June, '51, API	24,275	41,097
May, '51, BM	23,294	39,317
July, '50, BM	25,424	42,165

* on July 28

Fig. 8—Production and Demand of Natural Gas Liquids


NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
THOUSAND BBLS DAILY MONTHLY AVG

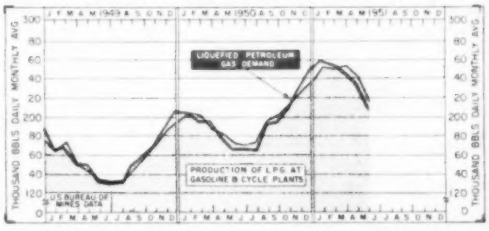
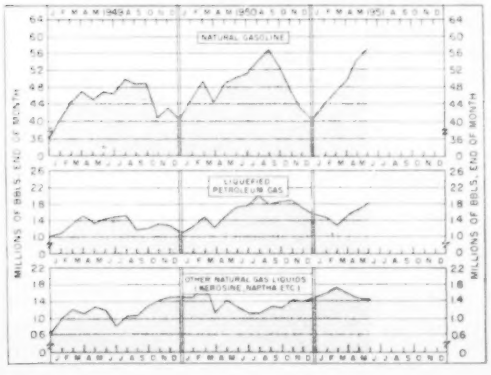

LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF LPG AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA
THOUSAND BBLS DAILY MONTHLY AVG

Fig. 9—Stocks of Natural Gas Liquids



Naural Gas Liquids Statistics

(Source) U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations

	Production (1000 bbl./day avg.) Natural Gasoline	LPG**	TOTAL	Demand* (1000 bbl./day avg.) Natural Gasoline	LPG	TOTAL
May, '51	318	219	537	316	209	525
May, '50	287	172	459	305	165	470
Change	+31	+47	+78	+11	+44	+55
% Change	10.8	27.3	16.9	3.6	26.6	11.7

	Total Production (1000 bbl.)			Total Demand (1000 bbl.)		
5 Mo. '51	47,227	36,768	83,995	46,157	36,267	82,424
5 Mo. '50	42,850	28,649	71,479	42,485	28,179	70,664
Change	+4,445	+8,119	+12,564	+3,672	+8,088	+11,760
% Change	10.3	28.3	17.6	8.6	28.7	16.7

	Stocks, End of Month (1000 bbl.) By Type of Product— Gasoline Natural	LPG	Products† Other	By Location— Refineries	Plants Gasoline	TOTAL
May, '51	5,757	1,859	1,485	5,047	6,002	9,679
April, '51	5,428	1,840	1,454	4,716	5,806	8,522
May, '50	5,079	1,729	1,355	2,852	5,311	8,163

* Demand, including exports but not transfers, is supplied from receipts from outside sources, as well as current production and stock changes at gasoline plants. Outside receipts in May totaled 106,000 bbls.

** Does not include LPG produced at refineries which in May totaled 2,617,000 bbls.

† Includes naphtha, kerosine, specialty and other products.

ADVERTISERS' INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card. . .no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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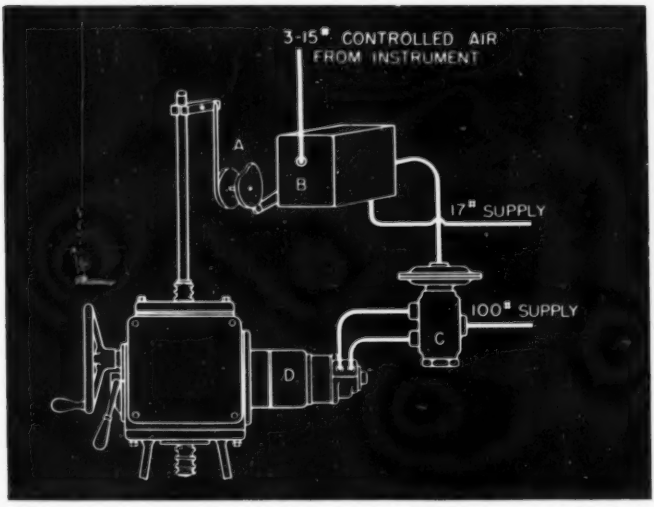
(F4) NATIONAL FOAM SYSTEM, INC. 912
(F5) NICHOLSON & CO., W. H. 890
(F6) NORDSTROM VALVE DIV., ROCKWELL MFG. CO. ..... Facing 860, 861
(F7) NORTON CO., THE 826
(F8) OAKITE PRODUCTS, INC. 802
(F9) OHIO STEEL FOUNDRY CO. 914
(G1) PENBERTHY INJECTOR CO. 890
(G2) PENNSYLVANIA SALT MFG. CO. 878
(G3) PETRO-CHEM DEVELOPMENT CO., INC. 873
(G4) PETROLEUM RECTIFYING CO. 923
(G5) PHILLIPS PETROLEUM CO. 904
(G6) POWELL CO., WM. 823
(G7) PRECISION SCIENTIFIC CO. 884
(G8) PRITCHARD & CO., J. F. 915
(G9) PROPORTIONEERS, INC. ..... Inside Front Cover
(H1) READ STANDARD CORP. 893
(H2) RIDGE TOOL CO., THE 920
(H3) ROOTS-CONNERSVILLE BLOWER CORP. 875
(H4) RUST-OLEUM CORP. 918
(H5) SHELL OIL CO. 820
(H6) SHERWIN-WILLIAMS CO., THE 867
(H7) SOLVAY SALES DIV., ALLIED CHEMICAL & DYE CORP. 896
(H8) STRONG CARLISLE & HAMMOND CO. 876
(H9) TAYLOR INSTRUMENT CO. 811
(I1) TRANE CO., THE 815
(E1) UNION CARBIDE & CARBON CORP., HAYNES STELLITE DIV. 888
(I2) UNIVERSAL OIL PRODUCTS CO. 820, 821
(I3) WARNER LEWIS CO. 922
(I4) WARREN PETROLEUM CORP. 827
(I5) WELDING ENGINEERS, INC. 832
(I6) WELL EQUIPMENT MFG. CORP. 900
(I7) WOLVERINE TUBE DIV. 894
(I8) WORTHINGTON PUMP & MACHINERY CORP. 813
(I9) WORTHINGTON PUMP & MACHINERY CORP. 825
(J1) WYATT METAL & BOILER WORKS ..... Outside Back Cover

WHAT'S NEW!

Equipment
Materials
Processes
Literature

Reviewed by WILLIAM C. UHL, Equipment Editor

Air-Driven Unit Operates Catalyst Slide Valves



How it works: positioner is actuated and controlled by regular air supply in the refinery

The "Cono Rotomotor" has been designed in a new model for the operation of catalyst slide valves on throttling control services. The Rotomotor, a pneumatic gear driven operator, provides accurate, sensitive, and positive positioning of these large valves. In the past it has been common practice to use hydraulic operators, which necessitate the expense of installing capital equipment for the hydraulic systems and present maintenance problems in pumping, piping, and containing hydraulic fluids. The pneumatic valve actuator, operating entirely from normal plant air supply, eliminates these problems.

Operating through a gear drive and threaded stem, the Rotomotor is basically a self-locking mechanism: a continuously connected handwheel and declutching lever also provide for manual operation if desired. Repositioning is accomplished by means of a tape type positioning device which permits long travels with accuracies of valve stem positioning to within 1/500th part of the total valve stroke. The device is available in a number of speeds, travels, stem diameters, and thrust loads. Units can be mounted with all internal piping at the valve manufacturers' factory and then shipped to the refinery as complete units ready for installation.

The drawing above shows how the unit works: positioning device (B) determines the *actual* valve stem position by means of tape and cam connection (A) and *desired* stem position by air impulse from the control instrument. Corrected output air pressure from (B) is then fed to auxiliary pilot (C) which ports main air supply to pneumatic motor (D) driving gear box clockwise or counterclockwise, repositioning stem, and completing pneumatic control loop. Conoflow Corp., 2100 Arch St., Philadelphia 3, Penna.

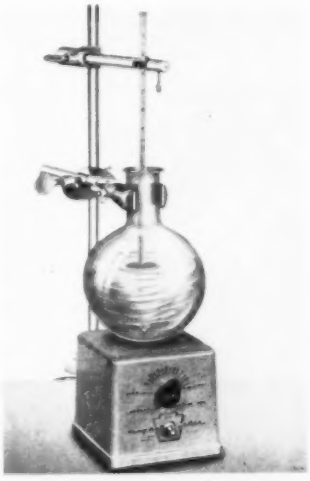
Circle No. 1 on Reply Card

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage required.

Agitators Coated with Teflon Offered In New Laboratory Magnetic Stirrer

"Magne-Stir" is a new magnetic stirrer for laboratory use which incorporates Teflon-covered stirring magnets that will not break and are resistant to all acids and alkalis. The stirring bars are available in three sizes. If desired, they can also be furnished in Pyrex glass-covered design in several sizes. The drive motor will stir one liter or more of liquids up to the consistency of 60% glycerol solution. Speed can be varied from barely turning to vigorous churning. A separate on-off switch permits turning unit on or off with disturbing the speed adjustment. Cast aluminum housing is designed either for use directly on a bench or table, or for mounting on any part of a set-up frame. Laboratory Industries, Inc., 4710 West North Ave., Chicago 39, Ill.



Circle No. 2 on Reply Card

Water Eductor Solves Spent Clay Handling Problem

Engineers at the Marcus Hook refinery of Sun Oil Co. were able to solve a materials handling problem recently by eliminating a manual operation and thereby decreasing the time required to convey spent filter clay to a settling basin outside the building. An S&K Hopper Type Eductor was mounted on a movable platform with the hopper above and the eductor below the platform. When spent clay must be removed from any one of the ten filter shells, a movable secondary drum, or hopper, is rolled under the man-head of the filter shell to receive the spent clay. A gate in the secondary hopper is regulated to permit the proper amount of clay to feed into the eductor hopper. Pressure water, by-passed from the inlet line on the eductor, issues through the wash-down nozzles in the eductor hopper and washes the clay into the eductor chamber. Then pressure water, which issues through the nozzle of the eductor, entrains the clay and discharges through the flexible hose with sufficent force to carry the clay-water slurry to the settling basin. Schutte and Koerting Co., Dept. JF., Cornwells Hts., Bucks County, Penna.

Circle No. **3** *on Reply Card*

Automatic Infrared Gas Analyzer Is Redesigned for Wider Variety of Uses

For automatic analysis of plant process streams, Baird has redesigned its continuous recording, infrared gas analyzer, incorporating a number of features for more diverse applications. Typical service for which the instrument is known to be applicable include: 1) ethylene in ethane and methane; 2) methane in other hydrocarbons, illuminating gas; 3) ethyl acetate in toluene ethyl alcohol; 4) acetone in air; 5) carbon monoxide in air, CO_2, water; 6) carbon dioxide in air, CO, water vapor; 7) isobutane in n-butane, other hydrocarbons; 8) water vapor in CO, CO_2, N_2; 9) sulfur dioxide in air. The new model has been designed for improved maintenance, and greater adaptability to routine work in the plant because of increased accuracy and sensitivity and higher resistance to shock, temperature, and humidity conditions. Two explosion-proof models are available: one a composite assembly of voltage regulator, detector, and recorder; the other a remote control unit where detector may be as far as 600 ft. from recorder. The instrument provides continuous quantitative analysis for a single infrared absorbing component in a stream of gases. Ranges of concentration when calibrated for CO_2 to maximum sensitivity would be 0.1% for 100 scale divisions. Accuracy for that particular case would be ±1 scale division or ±0.01%. The instrument will operate any control device which can be used with Minneapolis-Honeywell recorders. Baird Associates, Inc., 33 University Rd., Cambridge 38, Mass.

Circle No. **4** *on Reply Card*

High Boiling Glycol Useful as Diesel Fuel Additive or a Selective Solvent

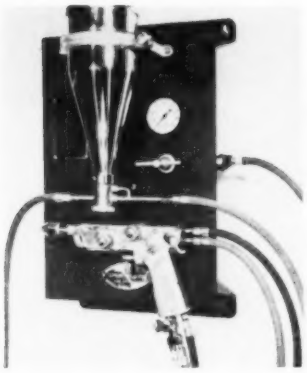
Dimethoxy tetraethylene glycol, a selective solvent with the property of miscibility in both water and organic compounds, has been made available again, in pilot plant quantities. A colorless, high boiling ether (275 C.) of high purity, its solvent power can be altered as desired by proper dilution with water or hydrocarbons. It contains no active hydrogen atom and is recommended as a reaction medium for Grignard and sodium condensation reactions. It has been used to purify such gases as acetylene, sulfur dioxide, etc. It has received successful tests, it is reported, as an additive to Diesel fuels to reduce the auto-ignition temperature of the fuel for cold starts. Quantities up to single drum lots are available for immediate delivery. Larger amounts will be available late in 1951. Ansul Chemical Co., Marinette, Wisc.

Circle No. **5** *on Reply Card*

New Field Manometer of Flexible Plastic Can be Rolled to Fit Pocket

Made of a flexible vinyl plastic material, a new field manometer can be rolled, twisted, or bent into any shape and still return to a full length, easily read, and accurate U-tube instrument. In rolled-up form, it will fit into the pocket. The plastic scale is held firmly between the tubes and can be adjusted. F. W. Dwyer Mfg. Co., 317 South Western Ave., Chicago 12, Ill.

Circle No. **6** *on Reply Card*



Powder Metallizing Spray Tool Has Closer Control, Longer Service Life

The new Model B "Spraywelder" includes a number of new features useful in the Colmonoy "Sprayweld" Process for powder metallizing: larger air filter, eye-level air gage, new trigger mechanism with finger tip control with lock for continuous or intermittent spraying, larger cooling chamber in head, and locked feed mechanism on carburetor which eliminates possible change in powder feed setting. The process consists of applying uniform overlays of hard-facing alloys using metallizing procedures, and then bonding the overlay to the base metal. Wall Colmonoy Corp., 19345 John R St., Detroit 3, Mich.

Circle No. **7** *on Reply Card*

New Rust Preventive Agent Developed For Use in Petroleum Oils, Waxes

Petrobase 210 is a new synthetic rust preventive composition for petroleum oils, petrolatums, and waxes, which can be used in small quantities. Its inherent polar activity causes oils and waxes to displace preferentially water from metal surfaces, and also prevents re-deposition of aqueous vapors or liquids on the metal. It is recommended by the manufacturer for use in the following four types of service: 1) government specification preservative oils and compounds, 2) industrial preservative or "slushing" oils, 3) household oils used as lubricants for small motors, hinges, tools, appliances, etc., and 4) water displacement fluids which selectively "wet" metal surfaces causing a thin oily film to be deposited for rust prevention and finger-print suppression. Typical physical properties are: color, red-brown; sp. gr., 0.96/0.97 at 60/60° F.; 8.0 lb./gal. at 60° F.; S.S.U., approx. 3000 at 100° F., 100/125 at 210° F.; Flash pt., 390° F., C.O.C.; pour pt., 25° F., ASTM; neut. No., 1.0-1.5. Pennsylvania Refining Co., Butler, Penna.

Circle No. **8** *on Reply Card*

Multiple Point Temperature Controls Save Time in Engine Test Laboratory

A substantial increase in the number of engine test units one operator can handle is the time-saving advantage of twelve multiple-point controllers in the Research Dept. of Shell Oil Co.'s Martinez, Calif., refinery. Replacing manually-operated instruments, the battery of units is used for temperature indication and control in the fuels and lubricants test work. Known as the "Tag Celectray" Multiple Point Indicating Potentiometer Controller, each of the 12 instruments has six control points. Thus six tests can be controlled simultaneously by one instrument or 72 tests by the battery of 12. In the Martinez installation, 10 units are

used to contol flow of additional cooling water or steam to engine jackets, oil heat exchangers, fuel heat exchangers, etc. Two others are used with bearing test machines for controlling electric heaters. Illustration shows one of the 12 controllers. Tagliabue Instruments Div., Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

Circle No. **9** *on Reply Card*

DID YOU MISS THESE?

The following items, reviewed originally in the June "What's New!" have aroused considerable interest among readers. They are repeated here briefly as a service to those who might have missed them. For details or copies of literature, use the regular reply card in this issue.

"Scope" Provides Visual, Illuminated Inspection of Equipment Internals

The Testa "Borescope," an electrically-illuminated tubular optical inspection instrument, can be used to check inside walls and surfaces of hollow castings, engine cylinders, crankcases, and the like. Measuring $\frac{1}{2}$ in. diameter, $1\frac{1}{2}$ ft. long, it has an achromatized and fully corrected lens system. Magnification depends on distance of target from mirrors, varying from 2X to 6.25X. Illuminating bulb consumes 0.35 amps. at 12 v., has rating of 250 hrs. Testa Mfg. Co., 418 S. Pecan St., Los Angeles 33, Calif.

Circle No. **10** *on Reply Card*

Lab Size Temperature Controller Has Range to 500° C., Sensitivity of 0.5°

A low cost, sensitive, electronic temperature controller is available for use in laboratories or industry with various heating devices where close regulation of critical temperatures over long periods is desired. The "Phen-Trol" is a direct dial-setting type, with range to 500° C., sensitivity within 0.5° from any setting. It operates on 115 v., 60 cycle AC. Properly fused, it will handle loads up to 3000 watts. Iron-constantan thermocouple is encased in stainless steel. Phen-Trols, Inc., 15 Franklin Pl., Rutherford, N. J.

Circle No. **11** *on Reply Card*

Pressure Vessel Fittings

Taylor Forge Nozzles, Welding Necks, and Large Diameter Flanges, Catalog 501; 116 pages of engineering information on a complete line of seamless forced steel flanged outlets for pressure vessels, boilers, and heat exchangers; includes data covering standards of the Tubular Equipment Mfgrs. Ass'n., and a 44-page technical treatise on modern flange design. Taylor Forge & Pipe Works, Chicago 90, Ill.

Circle No. **12** *on Reply Card*

Ultra-Sonic Boiler Scale Protection

Save Money on Your Lime and Scale Prevention Jobs with Crustex; six-page technical bulletin describing the operation of an altra-sonic wave producing apparatus whose oscillations will remove solid limestone crust and scale from water and steam lines, boilers, and heat exchangers. Velan Engrg. Co., 1 Exchange Place, Jersey City, N. J.

Circle No. **13** *on Reply Card*

EXTRA DAILY BULLETIN

ANOTHER NATIONAL FIRST ★ ★ ★

New AER-O-FOAM® "99"

Smothers POLAR SOLVENT Fires

The 5-gallon AER-O-FOAM "99" container is readily identifiable by its distinctive yellow and red label to distinguish it from other types of foam.

AER-O-FOAM "99" . . . new liquid [illegible] anical foam! Now get positive, quick-acting protection on fires involving polar solvents or petroleum products.

When applied to fires fueled by polar solvents such as methyl, ethyl, isopropyl alcohols, esters, ketones and ethers as well as petroleum products, AER-O-FOAM "99" offers new, dependable, stabilized protection. It is easily generated. Provides smothering, closely-knit blanket of fire-killing foam. Will not readily disintegrate or break down. Thoroughly tested, it is easily applied with existing 6% devices.

CHECK THESE ADVANTAGES:

- √ Complete protection in automatic systems
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WEST CHESTER, PENNA.

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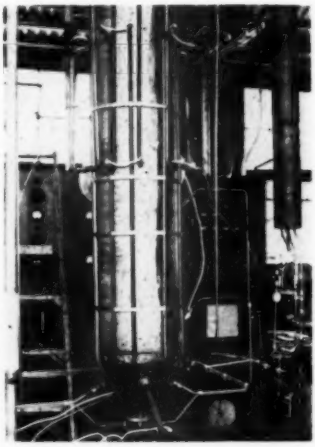
What's New!



Triangular Cross Section Heat Tube Improves Operation of "Lab Cracker"

Quick heatup, exact process heat, and easily duplicated temperatures up to 1100° F. are being obtained with electric heat in a pilot catalytic cracking unit at one Texas oil company laboratory. Mounted on the surface of the cracking vessel are a number of evenly-spaced "Chromalox" alloy-sheathed tubular heating elements, with a triangular cross-section which provides a flat contact surface for better heat conduction. Stainless steel bands hold the heaters in position. The illustration shows the heaters before insulation was put on the vessel. The heaters vary in length and are curved to fit the contour of the top and bottom of the vessel. Edwin L. Wiegand Co., 7605 Thomas Blvd., Pittsburgh 8, Penna.

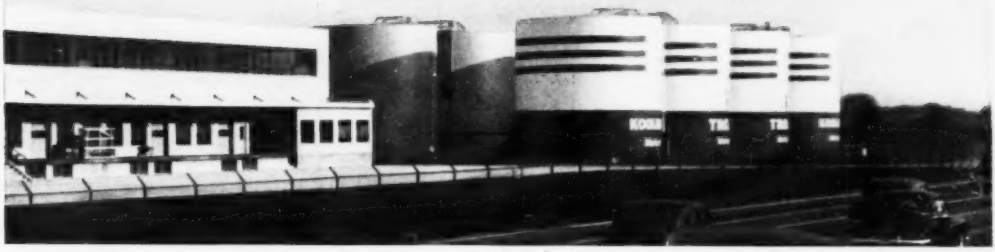
Circle No. **14** *on Reply Card*

Male Inlet and Female Outlet on Gage Valve Provides Easier Installation

Edward forged steel gage valves in the ½-in. size now include a model with a male inlet and female outlet. It requires no nipples—as for example, in hooking up pressure gages to pressure tubing or casing, because the male inlet serves the same purpose as a nipple. Compactness overall makes the valve suitable for cramped areas, as in instrument piping. Two designs are provided; the globe is designated as Fig. 152J and the angle as Fig. 153J. Ratings are 4000 lb. at 150° F. or 600 lb. at 750° F. A safety taper threaded joint between body and bonnet prevents the bonnet from backing out due to vibration, etc. Edward Valves, Inc., East Chicago, Ind.

Circle No. **15** *on Reply Card*

GRAVER TANKS
at CITIES SERVICE
COMPOUND PLANT
CICERO, ILLINOIS

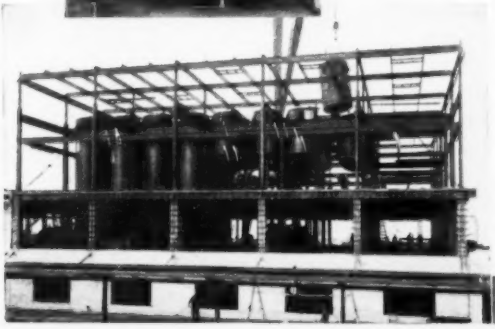


Stainless Clad by LUKENS
. . . Fabrication by GRAVER

Serving as the supply center for the Great Lakes and Midwest distribution areas, the new Cities Service compound and blending plant, near Chicago, will add a grease compounding section to its facilities. Important in this expanded operation are four large stainless clad storage tanks . . . fabricated and erected by Graver.

Altogether, there are 127 Graver tanks at this huge plant which now blends solvent-refined base stocks into super-quality "heart cut" motor oil. Supplied by barge from the Cit-Con lube oil plant at Lake Charles, La., the Cicero plant has a capacity of 50,000 gallons per day.

The fabrication of 93 shop-built and 34 field-erected tanks indicates the scope of Graver service in furnishing tanks and vessels in any quantity . . . any size and shape . . . carbon or special steels, solid stainless or stainless clad.



GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
NEW YORK · CHICAGO · PHILADELPHIA · WASHINGTON
DETROIT · CINCINNATI · CATASAUQUA, PA.
HOUSTON · SAND SPRINGS, OKLA.

GRAVER

OHIO
Return Bends

STRONG, SOUND FITTINGS

Ohio Type 1000 Return Bends are of the box-type design. They are efficient and economical for most operating conditions.

Ohio Type 1640 Return Bends are also of the box-type design. The type 1640 has stronger top construction and is recommended for higher operating conditions. Additional safety features are provided.

Both designs use Ohio's directional solidification casting principle. Write for descriptive bulletins.

THE OHIO STEEL FOUNDRY CO.
LIMA, OHIO — Plants at Lima and Springfield, Ohio

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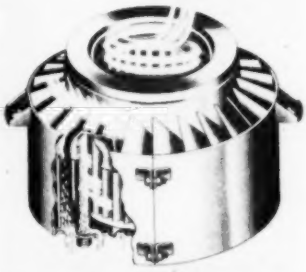
Cincinnati	Houston	San Francisco
Cleveland	New York	St. Louis
Dallas	Philadelphia	Tulsa

What's New!



Internal, Centrifugal Type Purifiers Have Three Stages for Separation

A new line of purifiers of the integral, centrifugal type is said to be low cost and to have a range of applications including use in steam drums, flash tanks, evaporators, packed towers, bubble-cap towers, deodorizers, and stills. Called the "Hi-Ef" Purifier, the unit is guaranteed by the manufacturer to deliver vapor with 1 ppm. or less of total solids. In operation, entrainment is removed in three stages. Vapor enters the top of the purifier as far away from the liquid level as possible, and passes downward in a rotary motion. This develops centrifugal force, which removes the greater portion of the entrainment at this stage. In the second stage, the rapid rotation is reduced to slow linear flow causing additional entrainment to drop out. Again in the last stage, further centrifugal force is developed effecting practically complete removal of any remaining entrainment before the vapor is discharged. The entrainment is discharged below the liquid level by means of ejects. The units are available in a range of sizes in fabricated steel, stainless, and other alloy materials. Sizes 4 through 10-in. are designed to pass through standard 10 x 16 and 11 x 15-in. elliptical manholes; sizes 12 through 36-in. for standard round manholes; and large sizes 39 to 72-in. can be furnished on application. V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

Circle No. **16** *on Reply Card*

High Speed Shearing Action Provided In New Laboratory Mixer Design

Designed for laboratory mixing operations where ordinary propellers generally are ineffective, the new Simplex Dispersator can be used for emulsification, dispersion, and intimate mixing. It is said to produce maximum turbulence and contact between various substances, liquid/liquid, liquid/solid or liquid/gas. The unit consists of a cylinder rotating at high speed. The centrifugal force

resulting from this rapid rotation forces the materials outwards through narrow slots in the cylinder wall under considerable pressure. As a result, the product is sheared at high speed as it passes through the slots, and the columns of liquid emerging from the slots are further sheared on coming into contact with the slower moving mass of liquid in the mixing vessel. Premier Mill Corp., 218 Genesee St., Geneva, N. Y.

Circle No. **17** *on Reply Card*

Trade Literature

CMP Records Manual

Records Research Reports on the Controlled Materials Plan, Booklet X-1203; manual outlining methods for simplifying paper work in connection with operation under CMP regulations, covering basic principles for controlling receipts of raw materials and parts, etc. Remington Rand, Inc., 315 Fourth Ave., New York 10, N. Y.

Circle No. **18** *on Reply Card*

Alloy & Stainless Castings, Fittings

Esco Stainless and High Alloy Products for the Process Industries, Bulletin No. 175; 68 pages of catalog information on pipe, pipe fittings, valves, castings, sheet and plate, bar, wire, etc.; including tables on temperature, hardness, weights, bursting pressures, and corrosion resistance data. Electric Steel Foundry Co., 2141 Northwest 25th Ave., Portland 10, Ore.

Circle No. **19** *on Reply Card*

Continuous Wax Moulding Unit

The Greer Automatic Wax Moulding Machine, a 10-page descriptive bulletin on a new automatic, continuous processing unit for making finished wax in slabs. (See story, this issue, pp. 840-843.) J. W. Greer Co., Cambridge 39, Mass.

Circle No. **20** *on Reply Card*

Fighting LPG Fires

LPG Fire Control; a 20-page, illustrated handbook for firemen and others who may be called upon to combat blazes in the presence of liquefied petroleum gas. Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y.

Circle No. **21** *on Reply Card*

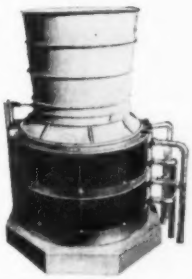
Steam-Operated Rotary Pumps

Warren Streamflow Rotex Pumps, Bulletin WQ-50; illustrates and describes a rotary type positive dis-

Pritchard's

NEW Quintair*

AIR COOLED HEAT EXCHANGER



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placement steam-driven pump for fluids of moderate or low viscosity at medium pressures, with dimensions, selection chart, and specifications. Warren Steam Pump Co., Inc., Warren, Mass.

Circle No. **22** *on Reply Card*

Magnetic Oxygen Recorder

Hays Magno-Therm Oxygen Recorder, Bulletin 51-829; 16 pages of engineering and technical information on operation, principles, methods of use, and features of an oxygen analyzer utilizing the paramagnetic properties of the gas. The Hays Corp., Michigan City, Ind.

Circle No. **23** *on Reply Card*

Hilsch Vortex Cooling Tubes

Belmont Hilsch Vortex Tubes, Form V-2-551; a leaflet describing the use, in these devices, of an internal vortex to separate a flow of compressed air (or other gas) into hot and cold fractions which can be used in a wide variety of ways to calibrate instruments, cycle-test equipment, cool thermocouples, etc.; including tables of specifications and prices. Thermo Instruments Co., 1221 El Camino Real, Belmont, California.

Circle No. **24** *on Reply Card*

Canary Island Lube Oil Plant

Heat Engineering, July, 1951, contains a nine-page article describing a new complete lube oil refinery at Teneriffe in the Canary Islands, operated by Compania Espanola de Petroleos and designed and constructed by Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

Circle No. **25** *on Reply Card*

Tank Agitators

International Top Entering Propeller Mixers, Bulletin No. 73, eight pages covering construction features, sizes and specifications, and a selection guide nomograph. International Engrg., Inc., Dayton 1, Ohio.

Circle No. **26** *on Reply Card*

Steam Trap Catalog

Nicholson Steam Traps, Catalog No. 751; 30 pages covering a line of steam traps, air, and gasoline traps; steam, air and gas separators, and the like. W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Penna.

Circle No. **27** *on Reply Card*

Ball-Bearing Swivel Joints

Chiksan Ball-Bearing Swivel Joints, Catalog No. 50-D, 20 pages; a four-page bulletin on dimensions, and a four-page bulletin on packing sets for these products. Chiksan Co., Brea, Calif.

Circle No. **28** *on Reply Card*

Corrosion Notebook

Notebook on Corrosion Resistance; 16 pages of data on the corrosion resistance of various types of stainless tubing and pipe, by type of corrodent at various concentrations; and including descriptions of general types of corrosion. Carpenter Steel Co., Alloy Tube Div., Union, N. J.

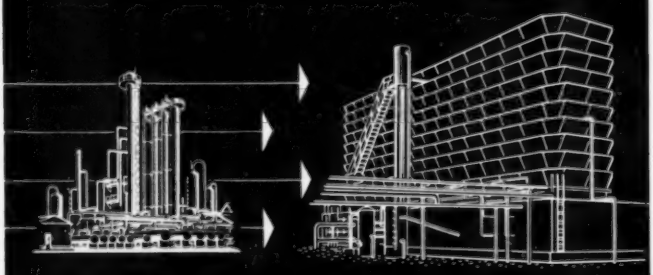
Circle No. **29** *on Reply Card*

How to Save Money with Steam

How Increasing Your Steam Costs Can Save Money, Booklet No. 2171, comprises a set of 16 questions and answers on the economical use of steam in heating and processing. Sarco Co., Inc., Empire State Bldg., New York 1, N. Y.

Circle No. **30** *on Reply Card*

HOW TO LICK YOUR



Cooling Water Problem

Water is the most common and widely used raw material. However, its use can . . . and usually does . . . pose an infinite variety of non-identical problems. Variables include the water itself, the plant equipment, operating conditions and many other factors. The proper approach to the solution of a cooling water problem . . . whatever its nature . . . is to engage the service of specialists who provide an adequate and well-balanced program of scientific control.

BETZ is an organization of engineers and chemists specializing in the solution of all industrial water problems. Over two decades of experience have made BETZ water conditioning service scientifically correct, complete . . . economical. Our nationwide staff of engineers welcome the opportunity of discussing your water problems. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa.

BETZ

COOLING WATER CONDITIONING • BOILER WATER CONDITIONING

What's New!

Air Pollution Meter

Air Pollution by SO_2 Recorded by Thomas Autometer, Folder ND 46-91(1); eight pages describing a new fully automatic analyzing and recording sulfur dioxide meter, operating on electrolytic conductivity principle, with range of 0-5 ppm. Leeds & Northrup Co., 4938 Stenton Ave., Philadelphia 44, Penna.

Circle No. **31** *on Reply Card*

Steam Trap Catalog

Steam Traps, Bulletin T-1740; 24 pages on an impulse type steam trap, how it works, how to figure sizes, etc., with capacity charts, application diagrams, typical installations, prices, specifications, etc. Yarnall-Waring Co., Chestnut Hill, Philadelphia 18, Penna.

Circle No. **32** *on Reply Card*

Vertical Centrifugal Pumps

Pacific Type WY Vertical Centrifugal Pumps, Bulletin 105-A, four pages describing pumps with capacities from 40 to 7000 gpm. at pressures to 500 psi., differential head to 1500 ft., temperatures to 700° F., at speeds to 3600 rpm; for loading, unloading, handling gas oils, kerosene gasoline, LPG's, or other crude and products services. Pacific Pumps Inc., Huntington Park, Calif.

Circle No. **33** *on Reply Card*

Corrosion-Resistant Paints

Corrosion-Resistant Tygon Protective Coating for Metal or Concrete, Bulletin 720; 16 pages describing line of plastic paints with tabulation of chemical resistance characteristics, recommended application procedures. U.S. Stoneware, Akron 9, Ohio.

Circle No. **34** *on Reply Card*

Heat Exchange Equipment

National Condensing and Cooling Sections, Catalog No. HT-20; 16-page booklet covering design features and physical characteristics, of heat transfer equipment; with design and engineering data, charts, and dimensional drawings. National Radiator Co., Heat Transfer Div., 60 East 42 St., New York 17, N. Y.

Circle No. **35** *on Reply Card*

Pipe Line Flow Measurement

Metering Flows in Crude Oil or Refinery Products Pipelines, Instrumentation Data Sheet No. 7.2-2; four pages outlining the operating principles and application of an electric flow meter system. Minneapolis-Honeywell Regulator Co., Industrial Div., Station 40, Philadelphia 44, Pa.

Circle No. **36** *on Reply Card*

Prevent Expensive Repairs and Avoid Shutdowns

Stop trouble before it starts.
Install ADSCO Strainers and Separators — keep operating equipment running at top efficiency.

ADSCO Y and T-Type STRAINERS keep the dirt and scale out of your equipment. Installed ahead of every regulator, pump, valve or trap, an ADSCO Strainer will reduce maintenance and prevent costly shutdowns. Designed with tapered seating of screen, and gasketed cap. Pressure drop no greater than through ordinary elbow. Sizes from ¼" to 6". For 9 to 1 screen ratio, and extra large pocket for sediment collection, use the ADSCO T-Type.

ADSCO SUCTION STRAINERS are used on lines carrying oil, water or other liquid. Usually installed on the suction side of pumps or other apparatus but can be used on discharge or other service. Solids are collected in large basket screen, easily removed for cleaning, and with quick opening cover. Straight through or offset connections in sizes from 2" to 10", for various pressures up to 300#.

ADSCO SEPARATORS remove moisture, oil and small solid matter from steam, air and gas lines. Deliver dry steam to equipment for increased efficiency. Available in vertical or horizontal types in sizes up to 10".

ADSCO RECEIVER SEPARATORS are recommended for use in steam lines to provide ample capacity for water or oil, and to eliminate pulsation from reciprocating equipment. Deliver steam at uniform pressure and separate slugs of water and oil. Optional piping connections. Large range of capacities. Sizes from 1½" to 12", 150 psi and 300 psi, and for temperatures to 650F.

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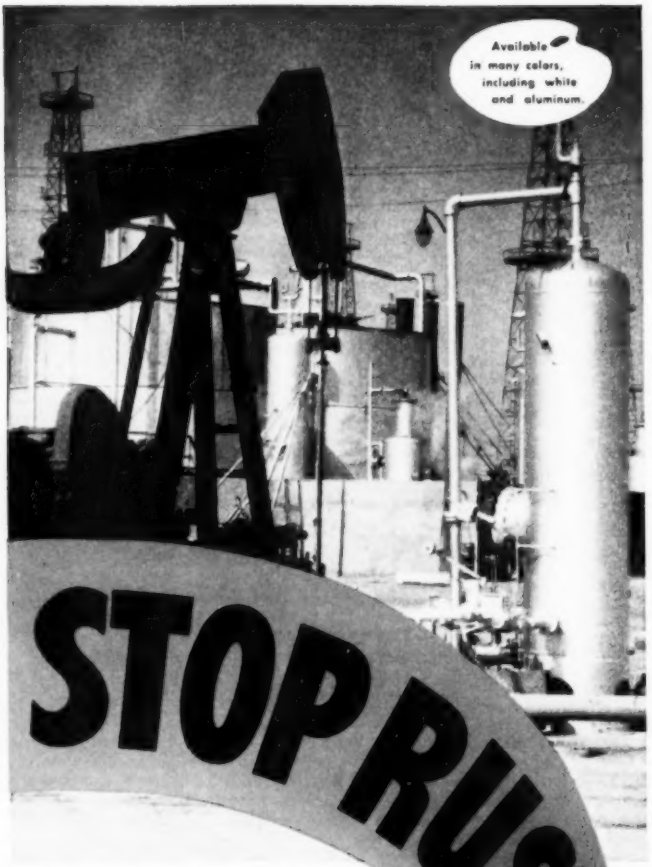
Completely revised—16-page Bulletin No. P-46-50A

AMERICAN DISTRICT STEAM CO., INC. • North Tonawanda, N. Y.

(To obtain more data on advertised products see page 908)



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Silently, but ruthlessly (even as you are reading this) rust is gnawing away at your tanks, pumps, derricks, refining equipment, buildings, roofs, fences—every rustable metal—inside and outdoors.

To protect your investment—to keep every possible pound of new steel for the defense program—*adopt rust control with Rust-Oleum as an important part of your maintenance program.*

RUST-OLEUM stops rust. It can be applied *even* over rusted surfaces. It is not necessary to remove all the rust. Just use wire brush and sharp scraper to remove rust scale and loose rust.

RUST-OLEUM can be obtained promptly from Industrial Distributors' stocks in principal cities of the United States and Canada. Write on your company's letterhead for complete catalog and nearest source of supply.

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2478 Oakton Street, Evanston, Illinois

• Stocked and Sold by Leading Industrial Distributors in All Principal Cities of the United States and Canada

What's New!

Organic Chemicals List

Supplement 37-3 *to Eastman Organic Chemicals List No.* 37; 12 pages listing 77 new chemicals, their molecular wts., structural formulas, melting and/or boiling ranges, plus latest price changes on all chemicals recently made. Distillation Products Industries, Eastman Organic Chemicals Dept., Rochester 3, N. Y.

Circle No. **37** *on Reply Card*

Residuum Oil Burners

Type SAR Oil Burners, Bulletin 23; four pages covering steam atomizing residuum oil burners, now available only in all-steel construction for greater safety in handling pitches, tars, uncut asphalt, tower bottoms, and fatty acids, according to the manufacturer. National Airoil Burner Co., 1284 Sedgley Ave., Philadelphia 34, Penna.

Circle No. **38** *on Reply Card*

Low Carbon Alloy Steel Tubing

B&W Alloy Steel Tubing, Low Carbon Grades for Mechanicals Uses, Bulletin TDC 149; four pages of condensed data on carburizing grades of tubing steels: microstructure, critical points, effect of alloy elements, forging, machining, welding and thermal treatment. Babcock & Wilcox Tube Co., Beaver Falls, Penna.

Circle No. **39** *on Reply Card*

Insulation of Cellular Glass

Foamglas Insulation for Piping and Process Equipment, A.I.A. File No. 37-B; 24 pages of engineering data, application data, and catalog information on line of glass foam insulation, with detailed instructions covering proper use and installation on pipe, fittings, process equipment, vertical and horizontal tanks, etc. Pittsburgh Corning Corp., 307 Fourth Ave., Pittsburgh 22, Penna.

Circle No. **40** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the bottom of the card and drop it in the mail. No postage required.

(To obtain more data on advertised products see page 908)

Steam Traps and Air Traps

Armstrong Steam Traps, Air Traps; a 12-page condensed catalog, with prices, on cast semi-steel and forged steel inverted bucket traps, compound steam traps, ball float air traps, Y-type strainers, and terminal check valves; with data on calculation of condensate loads, etc. Armstrong Machine Works, 213 Maple St., Three Rivers, Mich.

Circle No. **41** *on Reply Card*

Safety Shut-off Valves

Maxon Safety Shut-Off Valves, Bulletin 8000; four pages of specifications and data on line of automatic safety cut-off valves for furnaces, or boiler fuels, including natural, manufactured, and LP gases, light or heavy oils, coke oven gases; held open by electrical circuit and close in case of electrical current failure; suggested also for use on flammable liquid storage tanks, in sizes from 1 to 4 in. Maxon Premix Burner Co., Muncie, Ind.

Circle No. **42** *on Reply Card*

Petroleum Industry Rust Control

Removing and Preventing Rust in the Petroleum Industry, Field Service—Special Report B-900; four pages covering specialized materials and recommended procedures for rust removal, and prevention of rust on bare metal and under paint in maintenance and salvage on tanks, pumps, valves, fittings, tools, engines, and the like. Oakite Products, Inc., 150D Thames St., New York 6, N. Y.

Circle No. **43** *on Reply Card*

Filters for Air and Gas

Stayncw Pipe Line Filters for Air and Other Gases, eight-page brochure explaining the action, and giving specifications, of several models in a line of filters designed to protect air-operated tools, and instruments, and vacuum pumps and to filter and dry air, natural and manufactured gas, as well as all types of corrosive gases. Dollinger Corp., 11 Centre Park, Rochester 3, N. Y.

Circle No. **44** *on Reply Card*

Plant Protection in an Atomic Attack

How to Prepare Your Plant for Atomic Attack; 32-page illustrated booklet designed for management and safety personnel, prepared for all plants, large or small, by Walter Kidde & Co., Inc., 40 East 34th St., New York 16, N. Y.

Circle No. **45** *on Reply Card*

Literature Offered in this Issue's Advertisements

Do you need detailed information on any specific subject? Check through this easy-to-use index of literature offered this month:

ALLOYS, high-strength, nickel-base, corrosion-resistant; 40-page booklet. See adv't. p. S88.

BLENDING SYSTEM, continuous; descriptive literature. See adv't. inside front cover.

CATALYST, cracking; descriptive information. See adv't. pp. S00-S01.

CATALYSTS, cracking; samples and literature. See adv't. pp. S16-S17.

CLEANING and DESCALING materials and methods; 32-page booklet. See adv't. p. S02.

COMBUSTION CONTROLS, multiple fuel; Bulletin 5-S29 and Comparison Graph. See adv't. p. S04.

COMPRESSORS, centrifugal, for refrigeration; descriptive bulletin. See adv't. p. S25.

COMPRESSORS, reciprocating; descriptive bulletin. See adv't. p. S13.

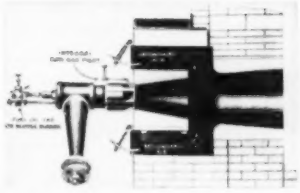
10,000 HOURS CONTINUOUS SERVICE "ON STREAM"

. . . not unusual for

THE NATIONAL AIROIL TANDEM COMBUSTION UNIT

TEN THOUSAND HOURS WITHOUT SHUTDOWN IS NOT "OVERTIME" for process oil heaters fired by the NATIONAL AIROIL TANDEM COMBUSTION SYSTEM firing dirty, wet refinery gas; uncut asphalt; refinery fuel oils . . . HOURS ARE LONG . . . PROFITS ARE HIGH . . . YOU will realize high profits from YOUR heaters when TANDEM COMBUSTION UNITS are specified.

Detailed information sent upon request on your business letterhead.



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The Handy Durable RIDGID Bench Yoke Vise

● You save time and effort with this more-for-your-money RIDGID Bench Vise. Right where you need 'em are its intregral pipe rest and benders that won't flatten pipe—and heat-treated tool-steel LonGrip jaws mean you don't have to be so fussy with polished pipe. Special malleable frame, extra durable. 8 sizes to 6" pipe, bench, post, stand and Tristand models, yoke and chain. Order from your Supply House.

RIDGID

★ Work-Saver Pipe Tools ★

THE RIDGE TOOL CO., ELYRIA, OHIO

What's New!

CORROSION INHIBITOR, for light petroleum products: technical information on use of Santolene C. See adv't. p. 809.

EJECTORS: Catalog 34. See adv't. p. 805.

FLOW METERS, gas, wet test: Bulletin 7-110. See adv't. p. 884.

GAGE ILLUMINATORS, explosion-proof: Data unit. See adv't. p. 862.

GAGES, liquid level: Catalog No. 35. See adv't. p. 805.

HEAT EXCHANGERS, air-cooled: Bulletin No. 11.0.080. See adv't. p. 915.

HEAT EXCHANGER TUBES, finned: Bulletin. See adv't. pp. 830-831.

HEAT EXCHANGER TUBING, aluminum: 24-page booklet. See adv't. p. 902.

HYDROFLUORIC ACID, aqueous and anhydrous: Technical Bulletin No. 30-A. See adv't. inside back cover.

INSTRUMENT CONFERENCE & EXHIBIT: preliminary program. See adv't. p. 903.

KNOCK engine: assorted literature on causes. See adv't. facing pp. 892-893.

MIST ELIMINATORS: 8-page bulletin. See adv't. p. 895.

MIXERS, vertical: Catalogue No. 600. See adv't. p. 872.

PACKING REMOVER: Bulletin DH PP. See adv't. p. 890.

PAINT, rust preventive: Catalog. See adv't. p. 918.

PIPE FITTINGS, long tangent elbows: Catalog 48. See adv't. p. 863.

PIPE FITTINGS, return bends. See adv't. p. 914.

PIPE FITTINGS, welded: W-3 WeldOlet Catalog. See adv't. p. 899.

PUMPS, cycling jet: Bulletin 6030. See adv't. p. 805.

PUMPS, sump, explosion-proof: Bulletin 4929. See adv't. p. 805.

REFRACTORIES, fused stabilized zirconia: Form 1409. See adv't. p. 826.

REFRACTORIES, unit-suspended: Catalog. See adv't. p. 812.

STEAM TRAPS: Bulletin 450. See adv't. p. 890.

STEAM TRAPS: Catalog No. 68-Q. See adv't. p. 876.

STRAINERS & SEPARATORS: Bulletin No. P-46-50A. See adv't. p. 917.

TANK CLEANING: 52-page booklet. Serial No. A-1134. See adv't. facing pp. 892-893.

TEL: assorted literature on its manufacture and use. Serial Nos. A-1210 and A-8820. See adv't. facing pp. 892-893.

TEMPERATURE CONTROL SYSTEM: Bulletin 98097. See adv't. p. 811.

THREAD COMPOUND, for high temperature service: free sample and data sheet. See adv't. p. 872.

TUBING, aluminum: Booklet entitled "Instrument Lines of Aluminum." See adv't. p. 889.

VALVES, control: Bulletin 272-2. See adv't. p. 880.

VALVES, control: Bulletin 700-2. See adv't. p. 883.

VALVES, control, air-operated: Bulletin PP. See adv't. p. 810.

VALVES, control, sizing data: Bulletin 750. See adv't. p. 883.

VISCOMETERS, Saybolt: Bulletin 7-705. See adv't. p. 884.

M. W. Kellogg Co. Celebrates Fiftieth Anniversary

During a recent 50th anniversary banquet at New York City's Hotel Commodore, more than 100 employes of The M. W. Kellogg Co., refinery and chemical engineers of New York, were each presented with an engraved gold watch in recognition of 25 years or more of service with the company. Shown here are **Warren L. Smith** (left), president of Kellogg displaying the watch with **Champ Carry,** President of Pullman, Inc., of which the engineering firm is a subsidiary. Others in the photograph are **Roy Walls,** Kellogg's personnel director, and **Herbert R. Schuster,** chairman of the committee which planned the banquet.

* * *

Five members of the research staff of Standard Oil Co. (Ind.) have been promoted. The men and their new positions are: **R. F. Marschner,** senior research associate; **B. L. Evering,** research associate; **A. P. Lien,** section leader; and **D. R. Carmody** and **C. E. Johnson,** group leaders. All are located at Standard's Whiting, Ind., laboratory.

Mr. Marschner

Mr. Evering

Mr. Lien

Dr. Marschner was graduated from Brown University and received a Ph. D., from Penn State College in 1936. He joined Standard's research staff in 1934 and has been a section leader since 1946. Dr. Marschner is the new chairman of the American Chemical Society's Chicago section.

Dr. Evering received undergraduate training at Loyola College of Baltimore, Md., and the University of Heidelberg. After receiving a Ph. D. from Johns Hopkins university in 1934, he joined Standard's research staff. He has been a group leader since 1943.

Dr. Lien was graduated from Ottawa, Kans., University and received a Ph. D. from Ohio State University in 1941. He joined Standard upon receiving his doctorate and has been a group leader since 1946.

* * *

Roy M. Teel has been appointed assistant to the manager of the natural gasoline department of Phillips Petroleum Co.

H. R. Legatski, who has been superintendent of operations, has been named project development engineer for Phillips Chemical Co., a subsidiary of Phillips Petroleum. In this newly created job Mr. Legatski will evaluate the technical aspects of projects for the company. **Louis P. Sumpter** succeeds him as superintendent of operations.

In other changes **W. L. Culbertson** has been appointed chief engineer in charge of the engineering division, succeeding Mr. Teel; **C. R. Ringham** has been appointed director of the section of coordination and analysis of the engineering division, succeeding Mr. Culbertson; **L. H. Moore** has been appointed superintendent of the division of contracts and settlements, with **R. H. Clark** to direct the settlement section; **H. R. Markley** has been named assistant to Mr. Sumpter in charge of plant operations, and **W. L. Phillips** has been appointed western district superintendent at Odessa, Texas, to succeed Mr. Markley.

* * *

Henry A. Heiss has been appointed manager of Pan-Am Southern Corp.'s Destrehan, La., refinery. The position of Destrehan manager is a new one, and its creation does not affect the positions of other top officials at the refinery, according to the company. **J. D. Tufts** will continue as refinery superintendent, with **R. L. Argus** and **V. G. Relimpie** as assistants.

Mr. Heiss, 42 comes to Pan-Am Southern from Indiana Standard, where he was general foreman of the light oils division, supervising the operation of catalytic cracking units. Earlier he served as general foreman of Indiana Standard's heavy oil operations.

* * *

Dr. P. C. White has been appointed manager of research and development for Pan American Refining Corp. Dr. White has made his headquarters at the Company's main research laboratories in Texas City, Texas.

Dr. White

Dr. White comes to Pan American from the research department, Standard Oil Co. (Ind), He entered the petroleum industry in 1935, immediately after receiving a Doctor's degree in chemistry from the University of Chicago.

Mr. Hopkins

In 1950 Dr. White was appointed division director, fuels and special products division at the Whiting Laboratory.

Also announced are two promotions in the research staff at Texas City. **M. C. Hopkins,** previously coordinator of research and development, has assumed the duties of technical director. In this position, Mr. Hopkins will be directly responsible for all phases of chemical engineering work. **Dr. J. E. Kasch** advances from assis-

tant director to associate director. Working directly under Mr. Hopkins, Dr. Kosch will be in charge of process development, process design and economics.

Mr. Kopkins came with Pan American in 1937 from Freeport Sulphur Co. He received his B. S. Degree in chemical engineering from Rice nstitute in 1931. Dr. Kasch came with Pan American in 1942, after completing his Doctor's work in chemical engineering at the University of Texas. During the World War II, Dr. Kasch was in the refining division of the Petroleum Administration for War.

* * *

George C. McLaren, general superintendent of the natural gasoline department of Standard Oil of California, southern district, has been elected president of the California Natural Gasoline Assn., replacing **R. S. Tulin,** Shell.

* * *

Warren H. Kraft, director of Honolulu Oil Corp., was elected vice president, and **E. R. Millett, Jr.,** was reappointed secretary-treasurer.

In addition to past presidents who are ex officio members, the following were appointed to the executive committee: **F. E. Bradley,** C. C. M. O.; **C. L. Case,** Continental Oil Co.; **R. C. Enderly,** Wilmington Gasoline Co.; **Fred Hartley,** Union Oil Co.; **Ray Hull,** California Research Corp.; **C. L. Hutchings,** Tide Water Associated; **E. W. Walker,** Western Gulf Oil Co.; **P. E. Foote,** Petrolane, Ltd.; **M. L. Fort,** Pacific Lighting Gas Supply Co.; **Grove Lawrence,** Southern California Gas Co., and **Winton J. Heinz,** Ingersoll-Rand Co.

* * *

Reginald J. S. Pigott, director of the engineering division of Gulf Research & Development Co. of Pittsburgh since 1929, has been nominated as 1952 president of The American Society of Mechanical Engineers. Mr. Pigott heads a slate of new ASME nominees, including four regional vice presidents and two directors-at-large, submitted by the society's nominating committee. Since only one name is presented for each office, nomination is tantamount to election.

* * *

J. E. Swearingen has been appointed general manager of production of the Standard Oil Co. (Ind.) at Chicago. He has been a director and assistant to the executive vice president of Stanolind Oil and Gas Co. at Tulsa.

Mr. Swearingen joined Standard Oil Co. (Ind.) in 1939 as a chemical engineer in the research department at Whiting, Ind. After holding several positions in Standard's research department, he was transferred in 1947 to the manufacturing department of Stanolind. He was made assistant to the vice president in charge of operations in 1949 and, subsequently, became manager of Stanolind's central division with headquarters at Oklahoma City. Early this year he was transferred to Stanolind's general office in Tulsa, and soon thereafter was elected a director of the company.

Mr. Swearingen was graduated from the University of South Carolina with a B. S. degree in chemical engineering and received his M. S. degree from Carnegie Institute of Technology.

PROCESS ENGINEER

With at least 4 years' Refinery Experience, including Crude Operations, Vacuum Operations, Catalytic Cracking, and Polymerization. Midwest Refinery.

BOX 41

PETROLEUM PROCESSING

PROCESS ENGINEER WANTED

Recent graduate or chemical engineer with one or two years oil refinery experience desired. Letter should include details of education, experience, family and military status and salary expected. Personal interview can be arranged.

BOX 39

GLIDDOL

***by* Glidden**

THE *Proved* ADDITIVE MADE TO PRESCRIPTION STANDARDS BY THE...

Pacemaker in Soya Research

From the first shipment, Gliddol has been made under rigid laboratory control to prescription standards. Here is the finest soybean additive that can be used to improve the performance of lube oil, fuel oil, grease or gasoline.

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SOYA PRODUCTS DIVISION

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QUALITY Glidden PRODUCTS

Everywhere on Everything

EXCEL-SO

CALIBRATING TANKS

for displacement meters. Any capacity — Any Specification.

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COALESCERS

remove all free water from products streams prior to dessicant dehydration.

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EXCEL-SO

SEPARATORS

Coalesce and remove all free water from light petroleum products.

WARNER LEWIS COMPANY

P. O. BOX 3096-C • TULSA, OKLA.

GOOD OPPORTUNITY

for young

CHEMICAL ENGINEER

in petroleum and chemical fields

. . . furnace builders, specializing in petroleum and chemical heaters for crude distillation, cracking, etc., seeks services of young chemical engineer (recent graduate considered).

Excellent opportunity with small, well established firm located in New York City.

All replies confidential, our organization knows of this advertisement.

BOX 40

PETROLEUM PROCESSING

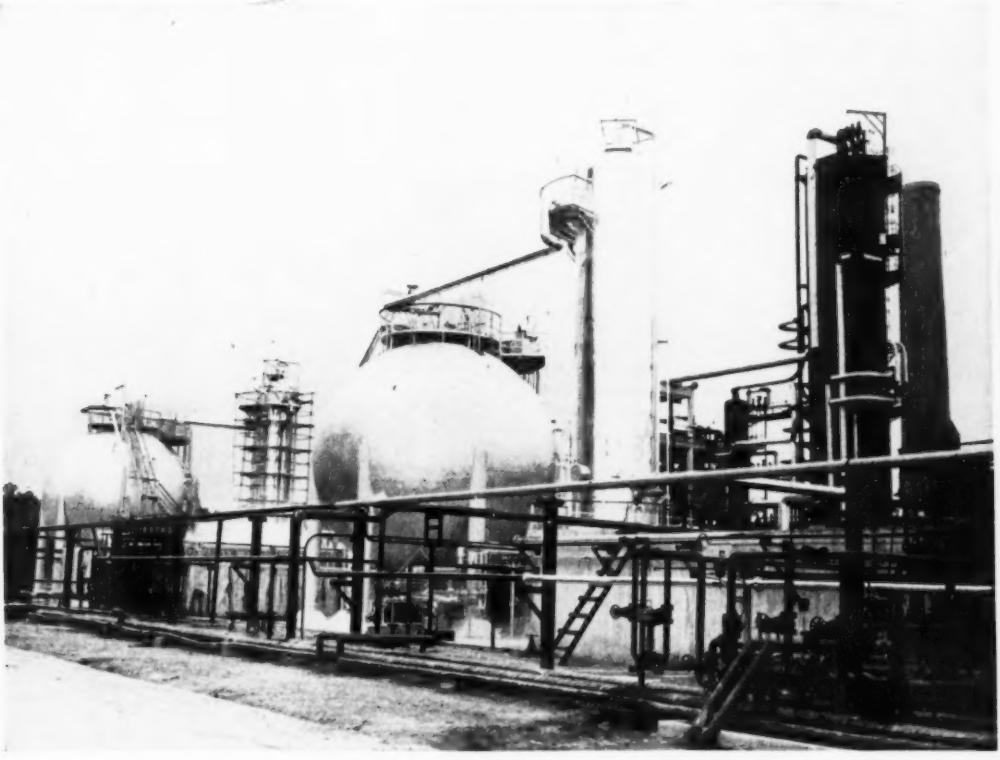
50 W. 50th St.

New York, N. Y.

(*To obtain more data on advertised products see page* 908)

CITIES SERVICE

another leading refiner desalts with PETRECO



Cities Service has long been recognized for progressive leadership, dependable excellence of product and refining know-how. The first Petreco Desalter for Cities Service was installed in their East Chicago, Indiana, refinery. When their great new refinery at Lake Charles, Louisiana, was built, Petreco Desalters were installed as part of the regular refining flow system.

There is only one way to earn a *repeat* installation for a company such as Cities Service, and that is to produce results the first time. In this particular case the Petreco Electrosphere to the right in the picture above has delivered throughputs as high as 75,000 barrels per day for extended periods of time and was a considerable factor in the topping units continuous fifteen months run during which 30,000,000 barrels of oil were processed. Results such as these are the reasons why leading refiners continue to specify Petreco Desalting and Petreco Service.

PETRECO PROVIDES COMPLETE DESALTING SERVICE AND FACILITIES

PETRECO

SPECIALIZED *Electric* PETROLEUM PROCESSES { DESALTING / DEHYDRATING

PETROLEUM RECTIFYING COMPANY

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1390 E. BURNETT ST., LONG BEACH 6, CALIFORNIA

PR 51 3

(*To obtain more data on advertised products see page* 908)

EDITORIAL VIEWPOINTS

Opinions and Comments on Current Topics

Plant Security Program Lags

LITTLE headway seems to have been made this past year in organizing the refining industry in the effort to strengthen the plants' internal security provisions against sabotage, subversive activities and even outside attack. For more than six months a special American Petroleum Institute Committee has been in charge of this task. What has been accomplished to date has been at individual plants where the management has taken the initiative in directing the work. In many instances, PETROLEUM PROCESSING staff writers in their visits to refineries have found alarming laxness even in screening outsiders who presented themselves at the gate for admittance.

This laxness could penalize the oil companies in more ways than one. In case of an actual emergency, or even great threat of one, it is likely that the matter of setting up plant security measures which refineries and other industrial plants without doubt would be required to follow would be taken over by outside government agencies whose personnel has had no experience in the operation of refineries. Even today, the inspection of refinery security facilities is in the hands of the Munitions Board, except for waterfront properties which remain in the jurisdiction of the Coast Guard. Too often the reports of the investigating officers call for protective measures which are costly to the companies and not warranted in the light of actual conditions.

In the last war, the work of making plant security inspections was under PAW, the actual inspecting being done by older retired workers and persons who had the confidence of the plant officials.

In the present instance it would seem that this duty of supervising plant protection should be a function of PAD, rather than to remain in the hands of the Munitions Board. In fact the PAD planned organization includes a Facility Security Division, which is as yet mostly unstaffed.

With this work in the hands of experienced personnel through PAD, it is likely that the industry's program for improving plant protection would have greater support of oil company executives than is now apparent. Also, in the event of an actual emergency and the need for greatly strengthening the security measures, the industry would be spared the costly and impractical suggestions that will certainly come if the responsibility for plant protection remains in the hands of an outside agency.

Management Must "Make" Scrap

THE National Production Authority and other government agencies are appealing to the oil companies to increase their metal scrap salvage efforts. They point to a critical present need and also to the continuance of the demand for scrap for some years ahead. This year, it is stated, the steel companies will need 32,500,000 tons of purchased scrap, some 3,500,000 tons more than a year ago. Next year they will need 35,000,000 tons.

The majority of refineries now have salvage departments that reclaim metal and sell to scrap dealers what cannot be reused within the plant. If scrap collections here are to be materially increased, it will be done through the plant managers earmarking for salvage equipment already obsolete and not in use but left standing for one reason or another. Such a program will benefit the company by taking off its tax books equipment beyond the stage of future usefulness, and by improving plant safety and housekeeping. This function of scrap collection is beyond the scope of the established plant salvage bureaus in most cases. In the present emergency organized scrap collection becomes a function of plant management which should be exercised.

Channel Black—A Victim of Progress

CHANNEL-PROCESS carbon black plants are slowly on their way out. No new channel plants reportedly have been built for the past several years and none are contemplated; on the other hand, several are shut down while some have been torn down and re-erected elsewhere.

Conversely, production of furnace-process carbon black has been increasing steadily and may amount to three-fourths of the total carbon black produced in the U. S. and United Kingdom by 1953. Until two years ago channel black accounted for half the total or more.

The reasons for the reversal are to be found in extensive production of synthetic rubber (particularly the GR-S type), continued research by the carbon black industry, increased cost of raw materials for black manufacture and greater demand for the natural gas from which channel blacks are made.

The furnace blacks impart much the better properties in finished synthetic rubbers for tire manufacture and allied uses, and fortunately are interchangeable with the channel blacks in the compounding of natural rubber. Moreover, furnace blacks are outstanding in the properties imparted to "cold" GR-S.

From the economic standpoint, furnace blacks may be produced from either oil fractions or natural gas; channel blacks only from gas. In either case the yields are much higher on a comparable basis by the furnace methods than by the channel process. The price for natural gas has continued to trend upward, in addition, consequently tipping the scales still further against the channel method.

We should not look down on the channel process, however, for there is much on the credit side of the ledger. It utilized much gas in its heydey which otherwise would have been flared; it brought industrialization to some areas much sooner than otherwise could have been expected, and it held the fort during the war until furnace black plants could be built. Channel black still is an important product.

For ANHYDROUS HF

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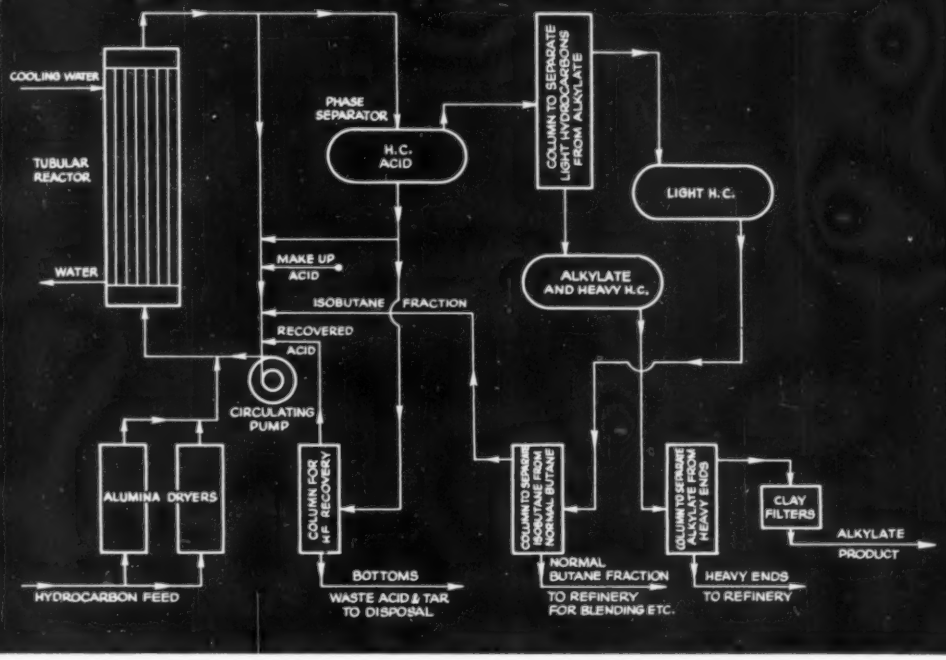

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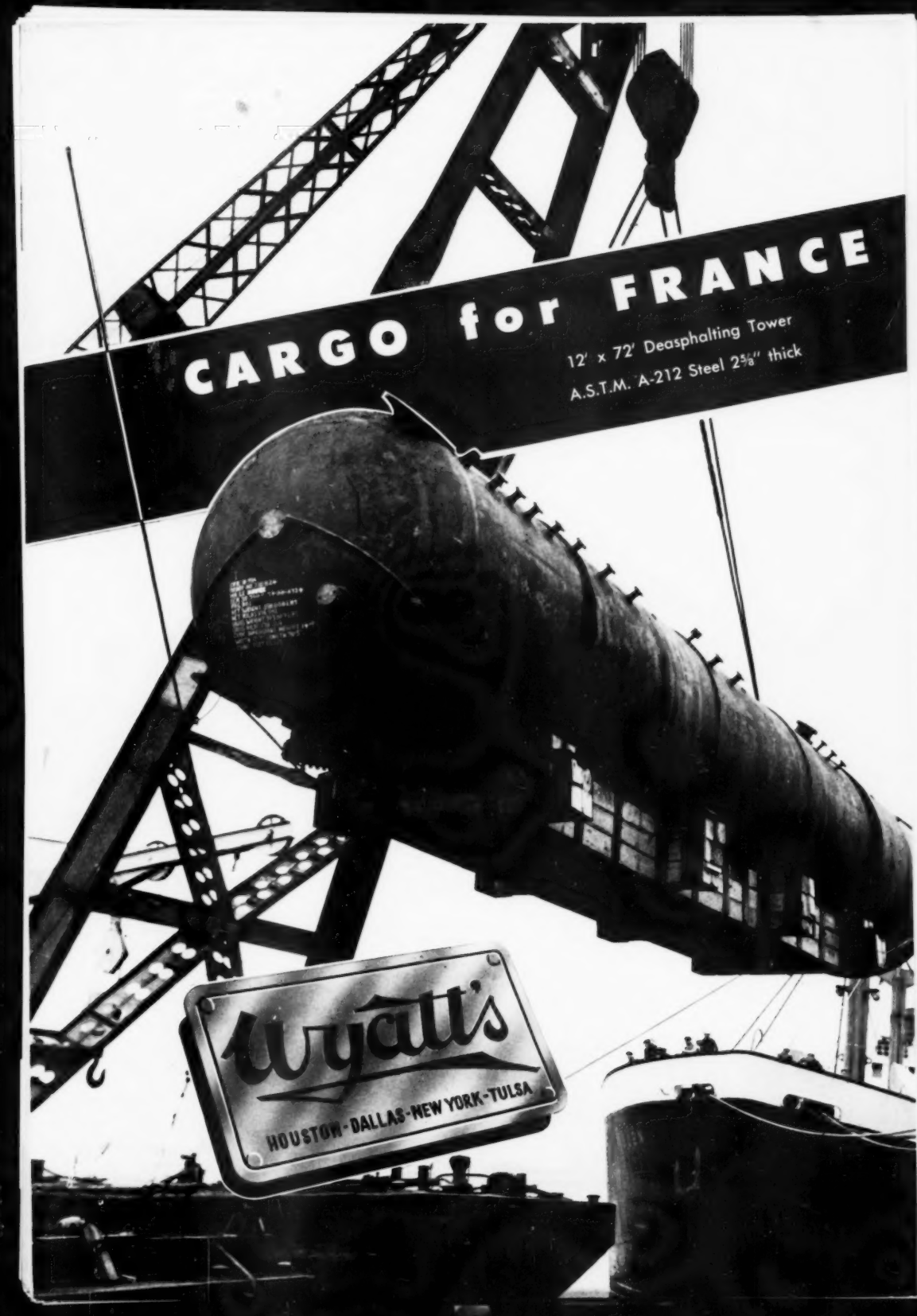
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